THE ENGINEER

Engineering and Marine Exhibition at Olympia.

Descriptive Supplement No. 1

INTRODUCTION

T the Engineering and Marine Exhibition, which opened at Olympia yesterday, gust 28th, and remains open until Satur-, September 13th, is concentrated the test post-war export sales effort yet de by the British engineering industry. er in the long and successful history of exhibition have organisers, F. Bridges and Co., L, had to plan ir space on such ple lines.

This year's exition is housed he whole of the n Hall and ional Halls at mpia, together h their galleries n increase of e than 45 per on the space sed at the last ibition, held in 7. Most of this e is taken by neering firms ch have exhibitfor many years Olympia, but e are also reented many s working in newer fields of neering produc- y war reorganion, sub-division specialisation. he general arement of the follows pre- practice of ionalisation, but st all the old ions are larger ever, there are several new ones, h are well supported. In the Foundry ion—started some years before the war e exhibits show a marked contrast een production methods before and the war. The Welding Section also ts considerable advances. Here both electrical engineer and the machine designer have influenced welding and ng plant development. Of particular est are the demonstrations by divers of rwater cutting by torch. Amongst sections is the Electricity Section, which des a popular exposition of radar, eby the public is permitted to watch eported progress of ships at sea.

twithstanding the difficulties of arrangocial and technical gatherings in these much attention has been paid to the me, accommodation and entertainment of the many technical associations which have habitually visited the exhibition.

Congratulations are due to the organisers for the fact that Lieut.-Colonel Lord Dudley Gordon consented to become the President of the Exhibition this year. His great experience of engineering and commerce has made itself widely felt.

As to the exhibits themselves, we begin in this Supplement, and in pages of the issue of THE ENGINEER which it accompanies, an account of those of particular interest. These are times, however, of great difficulty for exhibitors and editors alike and it must be recorded that the making of this account, which perforce was begun many weeks before the exhibition opened, was beset with more than ordinary difficulties. However, in a further Supplement next week and in articles in succeeding issues we will continue our descriptions of the exhibits, including those which for one reason or another could not be included earlier.

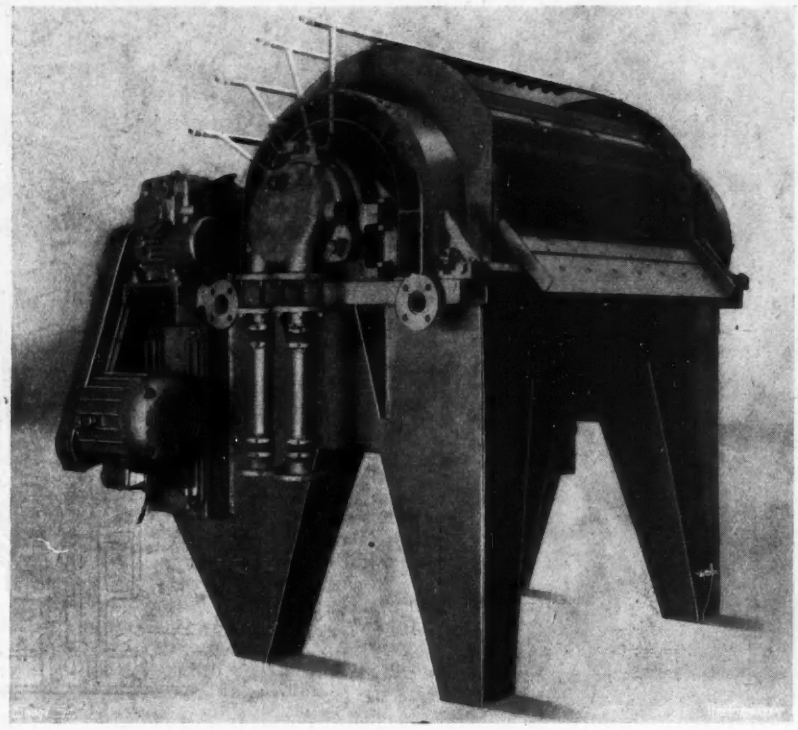


FIG. 1—ROTARY VACUUM FILTER WITH INDEPENDENT AGITATOR—PAXMAN

DAVEY, PAXMAN AND CO., LTD.

Particular interest attaches to the specially produced full-scale model of the Mark 12 "RPH V" oil engine, shown on the stand of Davey, Paxman and Co., Ltd., of Standard Ironworks, Colchester. This engine is a direct development of the power units which were designed and supplied for the propulsion of the British-built landing craft, and have already been fully described in our columns. The principal modifications incorporated in the latest design relate to problems of manufacture and accessibility, both of which have been greatly improved by arranging the engine to comprise a number of easily handled and self-contained assemblies. By this means, it is claimed, servicing operations have been made quicker and easier.

The engine has a bore of 7in with a stroke of 7¾in, and operates on the four-stroke cycle, with the Ricardo Mark III system of combustion. The twelve-cylinder model illustrated in Fig. 2, has two banks of six cylinders arranged at an included angle of 30 deg., and a six-cylinder "in-line" model is also available, which is the "V" type model with one bank of cylinders removed. By this means the output of an "in-line" model can be doubled by the addition of a second bank of cylinders. The six-cylinder engine has a designed output of 300 b.h.p. at the full speed of 1500 r.p.m., and the twelve-cylinder model an output of 600 b.h.p. at the same speed. A speed range of 500 to 1500 r.p.m. is obtainable. When supplied as a pressure-charged engine the outputs can be increased 25 per cent, and two blowers of the Roots type, one for each bank of cylinders, are fitted. The governor is of the hydraulic-servo type, and is readily adapted for either electric or pneumatic remote control, or for torque control in electric transmission schemes. Either electric or air starting can be used as may be desired.

Another "V" type engine shown is the six-cylinder "RPL" unit with a bore of 9½in and a stroke of 12in. It has been developed from the original Paxman totally enclosed, medium-speed unit, with a clerestory-type combustion chamber. It has a rating of

336 to 420 b.h.p. at 600 to 700 r.p.m., or when pressure charged it is designed to develop 450 to 562 b.h.p. at similar running speeds. Engines of this type constructed with fabricated steel frames were used exclusively by the Admiralty for the oil-electric propulsion of the "U" class submarine.

A smaller engine is the five-cylinder "RWM" type, with a bore of 5½in and a stroke of 7in. The rating of the model shown is 100 to 140 b.h.p. at 1000 to 1500 r.p.m. The engine is equipped with a mechanically operated reverse gear of the planetary spur-gear pattern, which is available either for a direct drive or a speed reduction of 2 : 1 or 3 : 1.

vacuum and pressure-tight cells, which while integral with the whole communicate separately with a valve head. There is a perforated filter plate, secured to the face of the drum, and the filter medium upon which the filter cake builds up may be of cloth, blanket, or metal gauze. The trough in which the drum rotates forms the slurry feed tank. An oscillating agitator in the trough prevents the solids from settling. Examples of the firm's boilers for industrial and chemical works are also on view.

ASSOCIATED BRITISH OIL ENGINES, LTD., AND BRITISH OIL ENGINES (EXPORT), LTD.

On the stand of Associated British Oil

rated rating of 60 b.h.p. per cylinder the b.m.e.p. is 81 lb per square inch, which is maintained with a maximum cylinder pressure of 750 lb to 775 lb per square inch and an exhaust temperature of 740 deg. to 760 deg. Fah. The specific fuel consumption is 0·375 lb per b.h.p.-hr. At the supercharged rating of 87·5 b.h.p. per cylinder the b.m.e.p. is 118 lb per square inch and is maintained at a maximum cylinder pressure of 775 lb to 800 lb per square inch and an exhaust temperature of 800 deg. to 820 deg. Fah. The specific fuel consumption under supercharged conditions is 0·370 lb per b.h.p.-hr.

The bed-plate, the design of which is shown in our illustrations, is made of cast iron

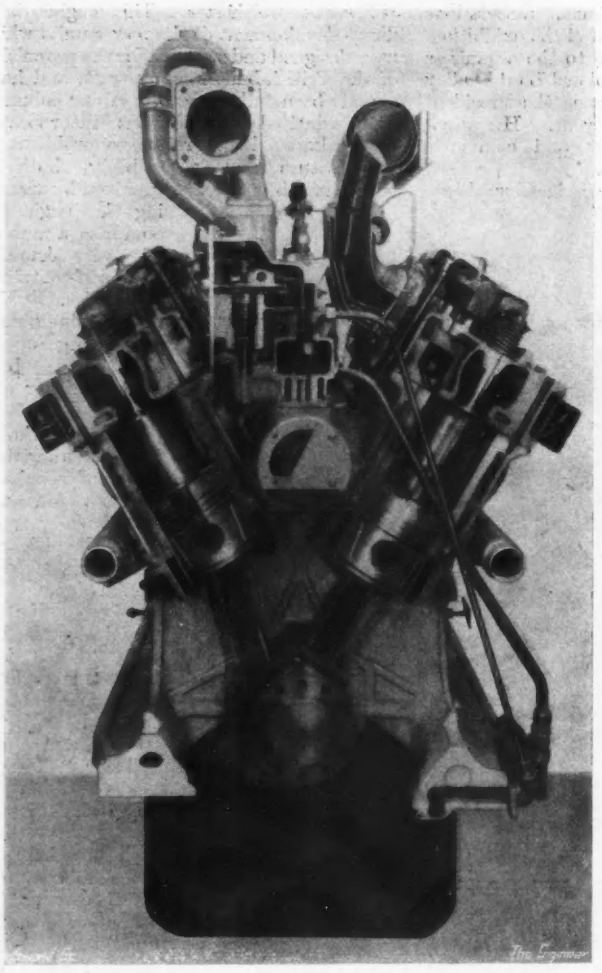


FIG. 2—MODEL OF TWELVE-CYLINDER, 600 B.H.P. "RPHV" OIL ENGINE—PAXMAN

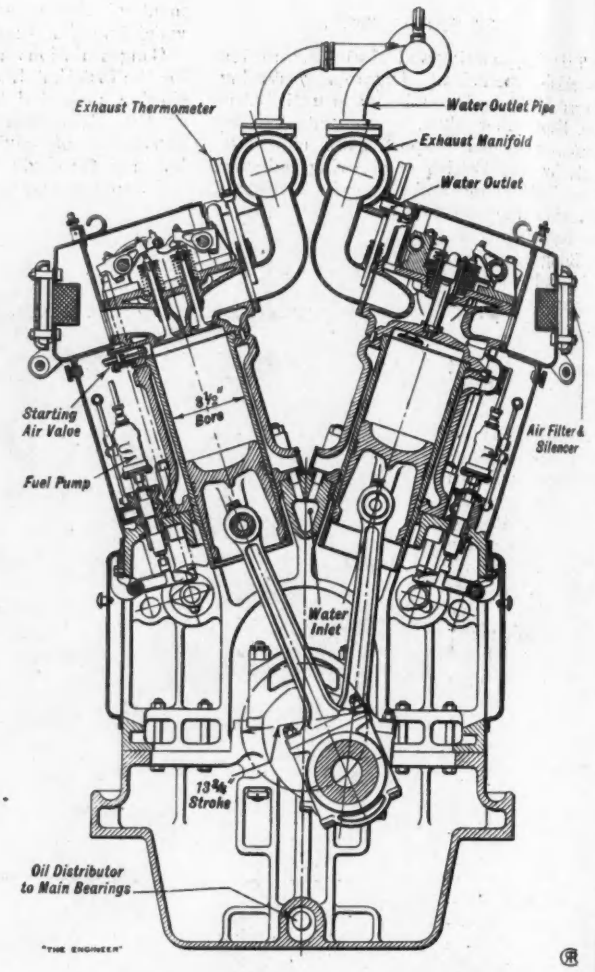


FIG. 3—CROSS SECTION THROUGH TWELVE-CYLINDER, 720 B.H.P. MIRRLEES OIL ENGINE—A.B.O.E.

The engine, which is shown in one of our Supplement pages, is also available in four and six-cylinder sizes.

The smallest engine on the stand is a Mark 4 "RQ" four-cylinder unit, operating on the four-stroke cycle, and having a bore of 4⅜in and a stroke of 5½in, with a designed output of 44 to 60 b.h.p. at speeds from 1000 to 1500 r.p.m. Most of the engines we have referred to are made for industrial use, power generation, marine propulsion and auxiliary work or railway traction.

A different class of exhibit shown on the same stand is a Paxman rotary vacuum filter, with an independent agitator and a drum drive. As will be seen from Fig. 1, the filter drum is supported on trunnions and is driven by an electric motor through spur and worm reduction gears. The drum consists of a number of self-contained

Engines, Ltd., a new exhibit is the Mirrlees "TV" engine, illustrated in section in Fig. 3 and in a side view in Fig. 4. It is based on the design of the company's earlier engine of the "TL" type. The cylinder banks are mounted on a new form of crank case, the cylinders being set at an included angle of 35 deg. This small angle results in a very compact engine, the overall width of which is little more than the width of the bed-plate.

The twelve-cylinder form we illustrate has a designed output of 720 b.h.p. when normally aspirated, and 1050 b.h.p. when supercharged by exhaust turbo-blowers, the maximum running speed being 750 r.p.m.

The cylinder dimensions are 8½in with a stroke of 13¾in. At the maximum piston speed of 750 r.p.m. the mean piston speed is 1720ft per minute. At the normally aspi-

It carries within it seven crankshaft bearings. An oil passage cast along the bottom of the bed-plate conveys lubricating oil directly to the main bearings. Cast iron bearing caps are bolted to the bed-plate by means of high-tensile steel bolts. All main bearings are positioned in the caps of the bearings so that they can be removed without having to disturb the crankshaft. Lifting lugs are cast at each end of the bed-plate, so as to enable the engine to be lifted complete without having to remove any components. The cast iron column is bolted to the bed-plate by sufficient bolts to ensure low stress and an oiltight joint. The separate cylinders are bolted to the column and, as will be seen from the section, Fig. 3, are positioned by the skirt of the cylinder casing, which is spigoted into the column. A water inlet passage is cast in the top of the

column, and it runs from end to end, thereby forming an inlet distributor to the cylinders. Short copper pipes and rubber sealing rings allow the water to pass into the cylinder jackets. Two camshafts are employed, carried in phosphor-bronze bearings, in housings in the column walls. The camshafts are readily accessible through the column inspection doors. These inspection doors are made in pressed steel and the door openings are of ample size to allow for the removal of the pistons and connecting rods, greatly facilitating routine inspection.

The crankshaft is a 40-ton carbon steel forging, hardened and tempered according to the provisions of B.S. Specification E.12, and machined all over. The crank pins are hollow and the crank webs are oval in shape, giving torsional strength combined with minimum weight and low centrifugal loading. The natural frequency of torsional vibrations of the shaft is high enough to keep the engine free from serious critical speeds within the running range. The main bearings have a steel lining, white metalled, and the fly-wheel end bearing is flanged in order to position the crankshaft. The gear wheel driving the two camshafts is made in halves, one portion being keyed to the shaft. The fly-wheel is attached to the solid forged flange of the shaft by eight fitted bolts. The camshafts are driven through intermediate gears at the fly-wheel end of the shaft and the shafts and gears are all made of 40-ton carbon steel. Air, exhaust and fuel cams for each cylinder are incorporated on a "Monikrom" sleeve, which is secured to the camshaft by cotter pins.

The main pistons are made from "Y" alloy and are of simple and strong construction. They carry three compression and two oil scraper rings. A gudgeon pin of Nitralloy hardened steel is used, of the fully floating pattern, and the pin is located endwise by Circlips. The palm-ended connecting-rods are of "H" section and are made from 40-ton steel stampings, as are the big end caps. The four high-tensile bolts in the big end have nuts which are spherically seated on washers to ensure that no bending stresses are set up when tightening. The cylinder jackets are secured to the column by eight high-tensile steel studs with spherically seated nuts, and the liners are of the wet type, flanged at the top and free to expand at the bottom, with two rubber sealing rings.

The cylinder heads are made from close-grained cast iron and are deep in section. They are secured to the cylinder jacket by eight high-tensile steel studs. Each cylinder head carries two air inlets and two exhaust valves with a central fuel valve. The fuel injector is surrounded by a rustless steel sleeve in the water space of the head which, it is found, gives an adequate cooling effect.

The valve heads are made of special wear-resisting cast iron alloy and the stems of high-grade valve steel. Hardened steel caps are fitted to the caps. The valve gear is operated by two push rods, and it is grease lubricated.

The air inlets are fitted with an air filter and silencer, and the exhaust manifolds are water cooled and are fitted with a dial type exhaust thermometer.

Lubrication is effected by a gear wheel pump, driven from the crankshaft, which draws its oil from the bottom of the bed-plate through a dual "Lolos" strainer. A pressure regulating valve and a pressure gauge are fitted at the control end of the engine. An automatic oil pressure failure stop device is provided, which stops the engine if the oil pressure, which normally is 20 lb to 25 lb per square inch, falls below 7 lb per square inch. A lubricating oil hand priming pump is fitted at the control end, along with a tachometer and the single hand lever for starting and stopping the engine. If desired, a vee rope driven circulating pump can be provided. The engine is started on compressed air, stored in an 11 cubic foot receiver at a pressure of 300 lb per square inch.

A Petter exhibit, of more than usual interest concerns the new method of finishing cylinder liners, which is known as the "Honeychrome" process. This new kind of liner, we are informed, is now being fitted to all Petter super-scavenge oil engines.

With the general increase in power per unit of cylinder volume, and the use of higher rotational and piston speeds, an improvement of the wear and heat-resisting properties of cylinder liners has now become an important problem. After many months of research at the Loughborough works of Petters, Ltd., in collaboration with the firm of Monochrome, Ltd., of Redditch, Worcestershire, this problem has been solved, it is claimed, by the introduction of a "lattice etched" chromium-plated liner. This new process has been patented by Monochrome, Ltd., and registered under the trade name of "Honeychrome." It makes use of a "40-carbon" steel liner, which has been developed in co-operation with the Chesterfield Tube Company, Ltd., of Chesterfield, and is chromium-plated to a depth of about five to six-thousandths of an inch, with a dense chromium deposit. This deposit is then "lattice etched" all over, so that the surface of the liner is uniformly mottled with depressions approximately $\frac{1}{8}$in in diameter and $\frac{1}{4}$in. apart. The finished surface, which has great hardness up to a Brinell number of 450, is not further treated either by grinding or by honing.

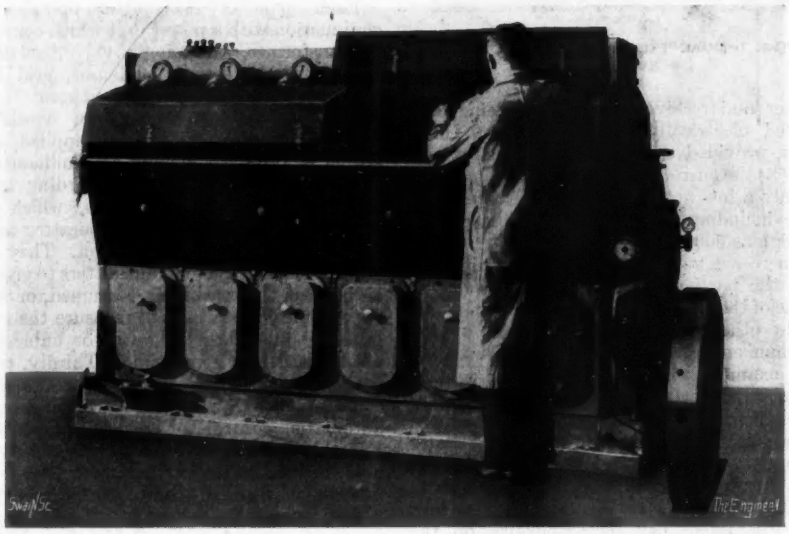


FIG. 4—TWELVE-CYLINDER, 720-B.H.P. MIRRLEES OIL ENGINE—A.B.O.E.

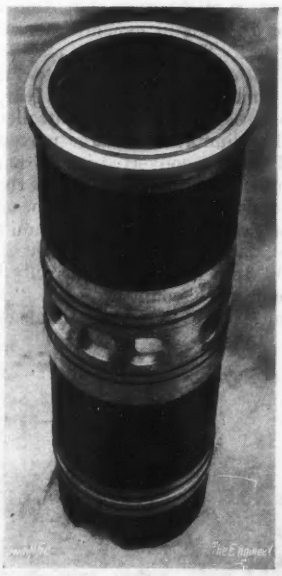


FIG. 5—CYLINDER LINER WITH "HONEYCOMB" FINISH—A.B.O.E.

A view of a typical "Honeychrome" liner is reproduced in Fig. 5. A steel liner is preferred to one of cast iron, owing to the well-known difficulty of getting good adhesion between the chromium deposit and the cast iron, which inevitably contains graphitic carbon, silicon and other inclusions. In the case of steel, however, it is possible to obtain molecular adhesion between the steel and the chromium, so that flaking or peeling is eliminated. Furthermore, the preparation of the steel liner from a solid-drawn, heat-treated tube facilitates production, both as regards time and cost, and complete homogeneity of liner material is thus assured.

Experiments have shown that the order of wear with the new type of "Honeychrome" liner is of the order of one-eighth of a thousandth of an inch per 1000 hours' run. When wear does take place an advantage is that the liner can be replated and lattice-etched to its original dimensions.

Other exhibits on this stand include an example of the new Petter-Fielding "F.H." horizontal industrial type engine, recently described in connection with the Royal Show; and also several McLaren-Brush sets for emergency and industrial electricity generation and "Cub" engines for marine propulsion, dynamo driving and marine auxiliary service.

EVERSHED AND VIGNOLES, LTD.

A range of position controllers suitable for remote operation of mechanisms over distances varying from a few yards up to a quarter of a mile is exhibited by Evershed and Vignoles, Ltd., Chiswick, W.4. Each

controller comprises a transmitter electrically connected to one or more distant electric motors, called slave units. Any movement of the transmitter handle causes a proportionate movement in each of the slave units, which develop sufficient power to operate the distant mechanisms. The system is particularly suitable for the regulation of engine throttles, face plate controllers, cooling louvres, valves, and tuning condensers for large radio transmitters.

The transmitter contains a rotary switch which energises in sequence three windings in the stator of the slave unit, thus causing its rotor to turn in synchronism with the transmitter. The slave unit motor can be stalled without harm and since there is neither commutator nor brush gear, maintenance is negligible. The controller works within fine limits and a large movement at one end can be converted into a small one at the other, the relative speeds of the transmitter and slave unit being dependent on the gear ratio between the two units. For example, a 90 deg. movement of the "PV.10" transmitter produces only $^1/_{12}$ deg. movement when coupled to the "PV.12" slave unit. There are various kinds of transmitter; the transmitter "PV.32" (illustrated in Fig. 6), used mainly for engine throttle controls, has a limited arc of travel of 90 deg., while other models permit continuous rotation in either direction. A dual rotary transmitter (type "PV.47") is also available, and comprises twin transmitters operated by a single handle as illustrated in Fig. 7. A knob below each dial enables that particular unit to be disengaged both mechanically and electrically should it be necessary to rotate one transmitter without the other. Dual transmitters are employed for such duties as tuning condensers at large wireless stations.

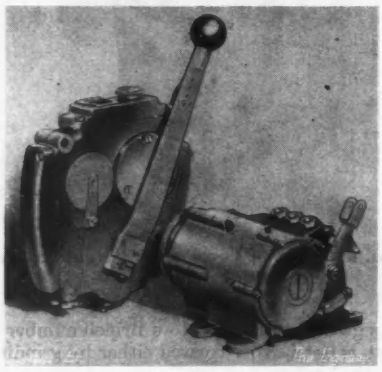


FIG. 6—THROTTLE POSITION CONTROLLER—EVERSHED

The Evershed position controller may be wound to operate on voltages from 20V to 50V d.c., and the current will vary from ½A to 2A, depending on the voltage.

Another Evershed exhibit is the recently introduced electronic repeater which is an electrical instrument for transmitting information to a distance and for controlling distant apparatus. Among the measurements that can be repeated are electrical quantities such as amperes, volts, watts; steam, water and gas pressures and flow; water level in reservoirs, and opening of valves, sluice gates, &c. Other functions that can be performed include the selection and control of distant switchgear and the summation of two or more measured quantities such as electrical power, gas or water flow, the information being transmitted to a central control point.

The electronic repeater consists of a transmitter connected by pilot lines to one or more distant receivers of the indicating, chart recording or integrating type. The transmission system is fully automatic and is not affected by variations in supply voltage or line resistance, while the number of receivers can be varied at any time without affecting the accuracy of transmission. The repeater operates on a.c. mains, while d.c. flows in the transmission circuit.

Only two wires are required between transmitter and receivers, the latter being connected electrically in series. Post Office lines, provided they are continuous, can be used as the current in the transmission circuit is only a few milliamperes. The loop resistance including that of the receivers can be as high as 5000 ohms.

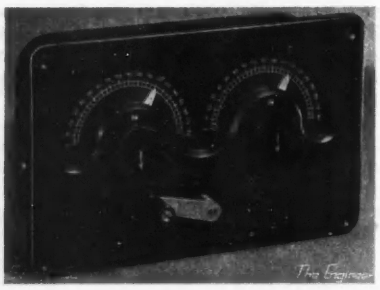


FIG. 7—DUAL POSITION TRANSMITTER—EVERSHED

There are various kinds of transmitter to suit the particular data to be transmitted. Some of these contain measuring instruments, while others are directly coupled to the mechanisms whose position is to be repeated. For example, the transmitter may contain a wattmeter originating movement, alternatively it may be of the mechanically operated type suitable for the transmission of water levels.

A steam pressure transmitter is shown in Fig. 8, with the case open to indicate how the instrument can be withdrawn on the guides F for servicing. The pointer of the instrument carries a coil C which works in a pot magnet B. This coil is in the anode circuit of a triode valve, the circuit being completed through the distant indicators and recorders which are connected electrically in series. The instrument pointer also carries a disc contact which is connected to the grid of the valve. This disc lies between two fixed contacts carrying positive and negative biasing voltages respectively. These alter the anode current of the valve until the torque exerted by the coil balances that due to the originating movement, which in this instance is a Bourdon tube E. A condenser connected across the grid circuit of the valve provides storage of the required biasing voltage.

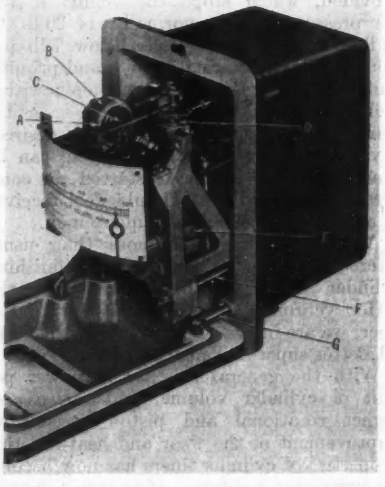


FIG. 8—ELECTRONIC REPEATER—EVERSHED

In cases where the torque obtainable from the coil is insufficient to balance that of the originating movement, or where the travel of the latter may not be restricted, the coil is carried on a separate pointer connected to the originating movement by a spring link D. Variations in line resistance or in mains voltage are automatically compensated for by the biasing contacts A, and the current in the transmission circuit is always maintained proportional to the quantity being measured.

To make the instrument dust tight, the front of the case is carried on spring hinges G. In this particular example the instrument case measures 8¼in by 10in by 10¾in, and is arranged for flush mounting on a panel.

Each type of transmitter operates in conjunction with a power unit which contains a transformer, thermionic valve, rectifier, smoothing choke and condenser, grid bias resistors, and a grid storage condenser.

Four types of receiver are available. First, simple receivers can be supplied, consisting of ordinary moving coil milliameters of the indicating or chart recording type. Secondly, integrating receivers, which are milliampere-hour meters incorporating automatic temperature compensation. They can be used with wattmeter transmitters to give, at a distance, the total kWh consumed, or with flow meter transmitters to measure the total quantity in gallons of water or cubic feet of gas used in a given time. Thirdly, relay receivers, consisting of milliammeter relays, can be arranged to operate alarms or provide automatic control of distant apparatus. Fourthly, power-driven receivers are available in which the milliammeter receiving movement, instead of indicating directly on a dial, operates a follow-up motor. Ample power is therefore available for driving large (6ft diameter) indicators, selector switches or other mechanisms.

GRESHAM AND CRAVEN, LTD.

Two compressed air-operated "Ejecto-pumps" are to be seen in operation on the stand of Gresham and Craven, Ltd., Ordsall Lane, Salford, Manchester. One of these pumps, to be seen in Fig. 9, is designed particularly for use in the chemical industry

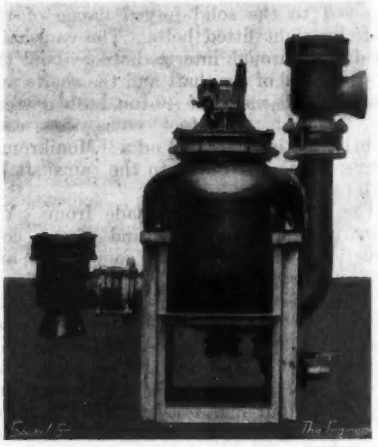


FIG. 9—CHEMICAL PUMP—GRESHAM

and is constructed of chemical glazed stoneware with stainless steel valves.

This type of pump, which is made in three standard sizes with outputs from 400 gallons to 2000 gallons per minute, has already been described in these columns and its method of operation can readily be followed with reference to the diagram we reproduce in Fig. 10. The diagram shows the pump in its suction period, during which compressed air flows in to the ejector past valve A, connected to the float rod. This air exerts a downward force on diaphragm B to keep open its associated isolating valve C. Through this isolating valve the ejector removes air from the casing. Liquid is drawn into the casing through a non-return valve from the suction pipe at the bottom,

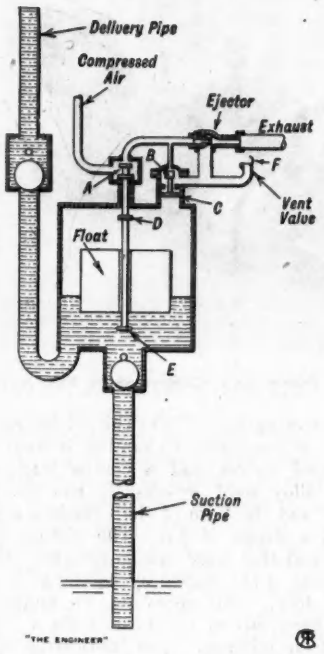


FIG. 10—DIAGRAM OF LIQUID PUMP—GRESHAM

and causes the float to move upwards until it comes into contact with the collar D on the float rod. As the liquid rises still further, the float exerts an upward force, which finally overcomes the compressed air pressure holding down valve A. This valve is thereby switched over to the top seating and held there by compressed air pressure during the delivery period.

During delivery air supply to the ejector and diaphragm B is automatically shut off by valve A, and compressed air is able to enter the casing past the float rod and forces the liquid drawn in during the suction stroke out through the delivery pipe. This continues until the float reaches the collar E at the bottom of the float rod, when the weight of the float, unsupported by liquid, pulls valve A down again to its lower seating. This action admits compressed air to restart the ejector and open the valve C. Any surplus air pressure left in the casing is vented to atmosphere through the valve F.

The pumps are self-priming and readily portable, and the whole apparatus, with its delivery piping, can be blown clear with the air pressure, if necessary. For cleaning purposes the whole head assembly, together with the float, can be withdrawn, without breaking the suction or delivery pipes, to leave the empty shell of the displacement chamber clear and fully accessible.

BRITISH OXYGEN COMPANY, LTD.

Together with its wide range of oxy-acetylene welding and cutting equipment, the British Oxygen Company, Ltd., Grosvenor House, Park Lane, London, W.1, is exhibiting a "Unionmelt" automatic submerged arc welding machine such as is used in the construction of welded ships, pressure vessels, &c. This process is now well known. Briefly it makes use of a bare rod electrode, which is fed according to the rate at which it melts and the necessity of keeping a constant gap between the end of the rod and the parent plate through the "Unionmelt" powder. The melt offers a certain resistance to the flow of current through the rod to the plate and heat is generated. The heat generated by the current is confined to a relatively small zone with a temperature estimated to lie between 2000 deg. and 2500 deg. Cent., but the wash effect of the superheated metal increases the area of the weld puddle. The end of the rod is quite close to the leading edge of the puddle, and the molten metal is carried backward from the rod to the top of the plate at an angle of less than 30 deg. During welding the fluid heated metal is thoroughly cleansed of all impurities and occluded gases, which, if not present in too great a quantity, escape through the layer of molten melt above the metal.

The photograph we reproduce in Fig. 11 shows one of the "V" type welding heads, together with its melt recovery unit and power pack. This head is designed to pull bare welding rod from $\frac{1}{16}$in to $\frac{5}{16}$in in diameter from a coil, straighten the rod, introduce the welding current, and feed the rod into the welding zone.

The head is designed to feed the rod in various directions in relation to the supporting bracket. It has a mechanism for guiding the rod in the desired position along the seam being welded, together with means for progressively depositing powder ahead of the welding zone.

The carriage on which the welding head is mounted is a compact unit driven by a built-in electric motor. In operation it is controlled by easily accessible switches and speed controls which are an integral part of the housing. It is adapted to run direct on the plate being welded or on a track.

An auto-guiding device on the head and the hinged mounting permit a guided motion to follow minor variations of the seam from the line of the carriage motion, so that errors in steering by the operator are obviated. The carriage has a speed range from 4in to 72in per minute. The rod reel holds approximately 25 lb coils of wire and is sufficient to weld a run of about 50ft in $\frac{1}{4}$in plate.

The firm is also showing its range of new extra heavy oxygen cutters which are designed for cutting steel from 18in to 84in thick. A feature of these new heavy cutting

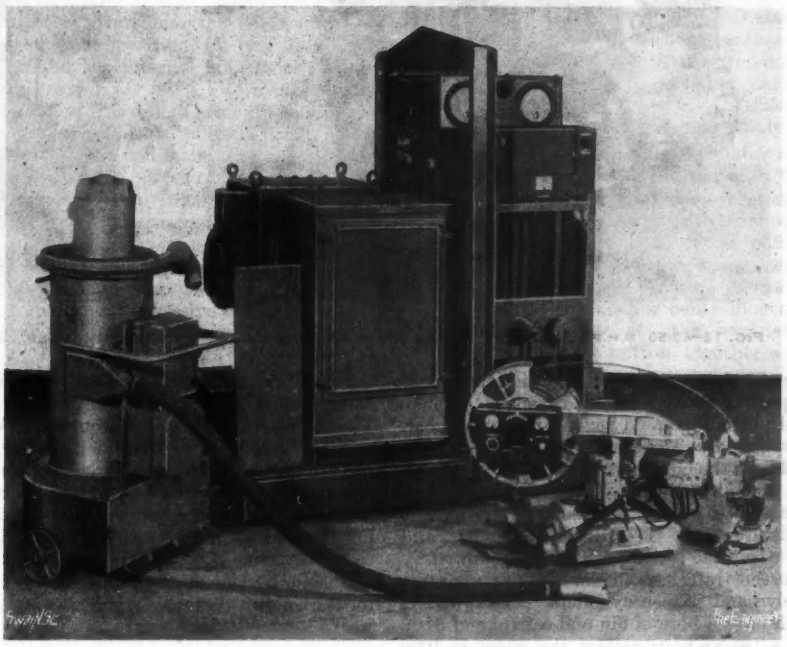


FIG. 11—"UNIONMELT" WELDING EQUIPMENT—BRITISH OXYGEN

blowpipes, which have already been described in these columns, is the reversal of the theory of using higher oxygen pressures for increases in thickness of material. With standard cutters capable of cutting steel 20in to 26in thick, oxygen pressures ranging from 90 lb to 150 lb per square inch have been required to force sufficient oxygen through a nozzle of some $\frac{1}{16}$in bore. With the new design of extra heavy cutters, while larger bore nozzles are employed for increases in material thickness, the cutting oxygen pressure at the nozzle inlet does not exceed 25 lb per square inch and this pressure tends to decrease as the nozzle size increases. For example, it has been found possible to cut steel over 48in thick using a pressure as low as 10 lb per square inch, with a nozzle of $\frac{3}{4}$in bore. When pressures in excess of 25 lb per square inch are used, the oxygen stream becomes unstable due to the setting up of zones of turbulence after the oxygen leaves the nozzle and these conditions materially reduce the effective depth of penetration of the cutter.

It has been found that hot alloy steel forgings, 44in thick and at a temperature of 1000 deg. Cent. can be cut at a speed of 2$\frac{1}{2}$in to 3in per minute with a $\frac{1}{4}$in bore nozzle and an oxygen pressure of 18 lb per square inch. A 48in thick forging can be cut

at a rate of 1½in to 2in per minute with a ½in bore nozzle and oxygen at a pressure of 22 lb per square inch.

THE NATIONAL GAS AND OIL ENGINE COMPANY, LTD.

On the stand of the National Gas and Oil Engine Company, Ltd., of Ashton-under-Lyne, an interesting exhibit, which is shown running, is the six-cylinder marine propulsion engine of the "M4AM6" type (see Art Supplement), designed to develop from 200 b.h.p. to 250 b.h.p., when running at a speed of 1200 r.p.m. It is shown complete with an oil-operated reverse-reduction gear, supplied by Modern Wheel Drive, Ltd., and both the engine and the gearbox controls are taken to a dummy bridge built near the centre of the stand. This type of engine is built in units of three to eight cylinders, and we learn that it will probably be followed by a further range of similar engines with ten, twelve and sixteen cylinders. The cylinders each have a bore of 6in and a stroke of 8½in. At a twelve-hour rating, the speed is 1000 r.p.m., with an output of 27½ b.h.p. per cylinder, the piston speed being 1416ft per minute, with a b.m.e.p. of 90 lb per square inch. The unit is available either as a main propulsion unit or an auxiliary generating unit.

A feature of the crankshaft design is the adoption of journals and crank pins with a diameter equal to 75 per cent that of the piston. Either heat-treated alloy steel is used, designed to give a Brinell hardness number of 250, or a cast shaft is employed, made in the company's own foundry from special iron of the acicular type, with an ultimate tensile strength of 30 tons per square inch. One of these cast shafts is on view, and attention may be drawn to the arrangement of oil holes. Each crank pin has two outlet holes connected with the main supply duct, and this feature, combined with the use of a top half big-end connecting-rod bearing, without oil-grooves, promotes, it is claimed, good lubrication and the formation of a strong oil film.

The design of the cylinder heads is somewhat unorthodox, in that the air inlet valves are arranged diametrically opposite each other, as also are the exhaust valves. Thus, on each side of the cylinder head there is one inlet and one exhaust valve, the fuel injection valve being in the centre. The inlet valves are masked which, combined with the arrangement of the valves, produces turbulence and gives good combustion with high efficiency. The performance of the engine is shown by the accompanying curves (Fig. 13).

The alloy pistons are pressed from a casting, by which the advantages of a forged structure are obtained with a cast surface which is favourable for running conditions. One of these pressed pistons is on view on the stand.

The pumps are driven from a single spiral bevel wheel mounted crankshaft, which drives a lubricating oil pump and two water circulating pumps. Any of these pumps can be easily removed by simply taking off the nuts from the mounting flange, each pump being complete with its overhung pinion. The oil filtering is very thorough and comprises, besides the suction strainer, an Auto-Klean strainer and three Streamline oil filters, each of which is built into a crankcase door. The fourth door is utilised for mounting the starting motor when electric starting is fitted.

The engine shown on the stand is arranged for starting with compressed air by means of a timed air admission to the cylinders from a distributor with non-return valves in each cylinder head. If desired, electric starting can be employed or use made of a small petrol or oil engine with a Bendix shaft and pinion drive.

It may be mentioned that provision can be made to mount the gearbox on a bell housing which encloses the fly-wheel, an arrangement which it is claimed, while giving rigidity, allows of easy and accurate installation. When using this type of engine for auxiliary generator driving, a similar arrangement can be adopted with a flange-mounted generator. The speed of such generating sets is usually about 750 r.p.m.

Another marine propulsion unit, which we do not illustrate, is the "DA6M" type, six-cylinder engine, a high performance unit with a designed fuel consumption of 0·35 lb per b.h.p. hour. It is completely enclosed, including both the dynamo and the starting motor. On this engine an open type of combustion chamber is used, with inclined valves and a central fuel valve. The alloy steel crankshaft has 3in crank pins, and the bore of the cylinders is 4½in., with a stroke of 6in. The pistons are so designed that they can be removed through the side of the engine by taking off a crank case door. This operation, we understand, has been carried out in as little a time as eighteen minutes. The lubricating system embraces a suction filter, with duplex Lolos filters and a built-in spiral tube oil cooler. The gearbox is of the S.L.M. oil-operated reverse-reduction pattern, designed and built by the National Company under licence. It has a 2½ : 1 speed reduction. This series of engines is available in two to six-cylinder units, with designed outputs of from 18 b.h.p. to 80 b.h.p. at speeds of 1000 to 1500 r.p.m.

We show in Fig. 12 a "DA5" type of five-cylinder generator unit with an output of 45 b.h.p. to 50 b.h.p., at 1000 r.p.m., direct-coupled with a flange mounting to a 400V, three-phase alternator. The exciter is mounted on the top of the alternator and is driven by a Texrope. This unit can also be made as a d.c. machine and such sets have been supplied to many shipping companies.

Another auxiliary, see Fig. 14, is the 8¾ b.h.p. "DSSH" single-cylinder engine, driving a 3½kW 110V Crompton d.c. generator next to the fly-wheel end and a Pulsometer pump beyond. This pump, which has a designed capacity of 15 tons of water per hour against a total head of 50ft, can be disengaged by means of a friction clutch. A Reavell air compressor is also V-belt driven from the coupling boss, and has a capacity of 8 cubic feet of free air per minute, at 275 lb per square inch. It is also provided with a clutch.

MAWDSLEY'S LTD.

The principal exhibits shown by Mawdsley's, Ltd., Dursley, Gloucester, are two examples of self-regulating and fully-compensated

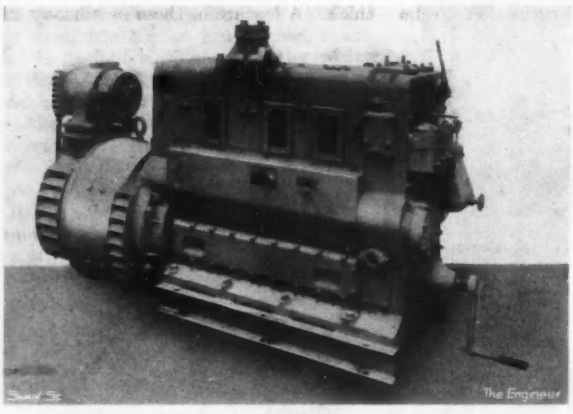


FIG. 12—45/50 B.H.P. AUXILIARY GENERATOR SET—NATIONAL

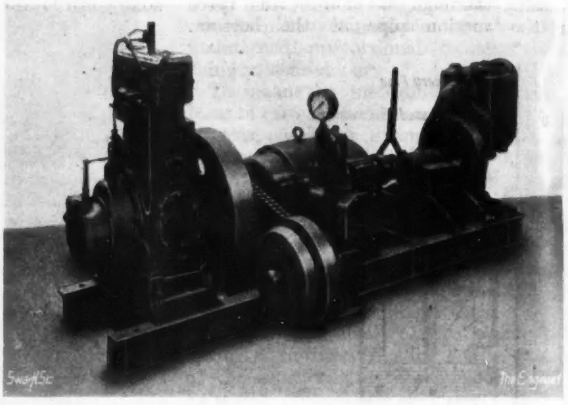


FIG. 14—8¾ B.H.P. GENERATOR, PUMP AND COMPRESSOR SET—NATIONAL

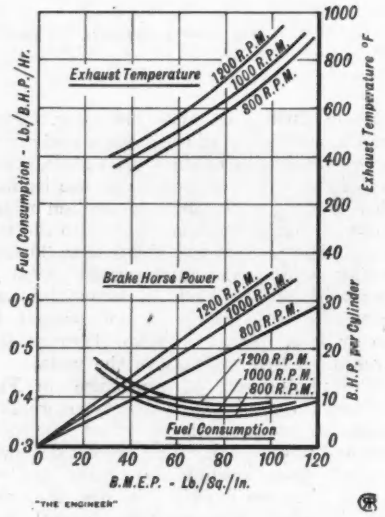


FIG. 13—PERFORMANCE CURVES OF "M4A" SERIES ENGINE—NATIONAL

alternators of recent design as illustrated in Figs. 15 and 16.

The self-regulating alternator has a rotating armature and is designed to maintain its voltage almost constant when running at constant speed, under any load provided the power factor remains constant. A small d.c. armature winding placed in the same slots as the a.c. winding provides self-excitation for the alternator. Self-regulation is obtained by disposing the d.c. armature

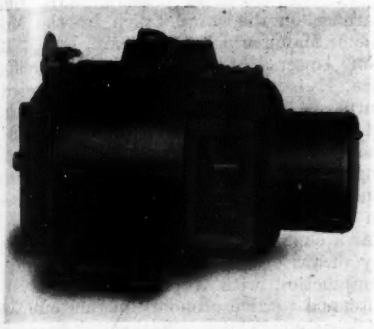


FIG. 15—SELF-REGULATING ALTERNATOR—MAWDSLEY'S

winding in the slots in such a position that an increase of current in the a.c. conductors increases the effective flux through and the voltage generated by the d.c. winding. This effect in turn increases the excitation current and overcomes the effect of armature reaction and internal impedance.

The actual value of the power factor at which such an alternator will maintain constant voltage can be adjusted on a given machine by altering the relative position of the a.c. and d.c. windings on the armature. This is effected simply by moving the d.c. brush position. With brushes set for level voltage at 0·9 power factor the voltage will rise slightly at unity power factor and fall slightly at 0·8 power factor. It is stated that, when set for level voltage at 0·8 power factor, a number of 22kW self regulating alternators which were supplied for service in India and Burma maintained the voltage at the grid limits of ± 6 per cent between power factors of 0·7 and 0·925 at full load and proportionately less at partial loads: for example, ± 3 per cent at half-load—a performance which is adequate for normal industrial usage.

Our illustration, Fig. 15, shows a self-regulating alternator wound for a 400/230V, 3-phase, 4-wire, 50 cycles per second supply, with a continuously rated output of 35kVA at 0·8 power factor when running at 1500 r.p.m.

Mawdsley's fully-compensated rotating armature alternator is designed to maintain its voltage almost constant at constant speed under any conditions of load and at any lagging power factor. The machine (like the self regulating alternator) is arranged for self-excitation by a small d.c. armature winding which is placed in the same slots as the a.c. winding. Constant voltage at all loads and power factors is obtained by a second d.c. winding, which is carried on a small auxiliary core mounted on the same shaft as the main armature.

This auxiliary core is excited by the current in the a.c. conductors and the auxiliary d.c. armature winding is so disposed in relation to the a.c. winding that an increased voltage is generated with loads of lower power factor. The d.c. excitation increases, therefore, with any increase of load current and any decrease of load power factor and this, in turn, overcomes the effect of both the value and position of the armature reaction and the internal impedance of the a.c. winding.

Machines of this design are built for three-phase or single-phase outputs and it is claimed that they will maintain their voltage constant to within ±3 per cent at any load or power factor. An important advantage of this class of alternator is its ability to maintain constant voltage at loads up to 2½ to 3 times full load current, so that relatively large motors on the system can be started up without excessive voltage drop.

Typical of this range is the machine shown in Fig. 16, which depicts a fully-compensated alternator wound for 400/230V 3-phase, 4-wire, 50 cycles per second supply, and having a continuously rated output of 27½kVA at 0·8 power factor when running at 1000 r.p.m.

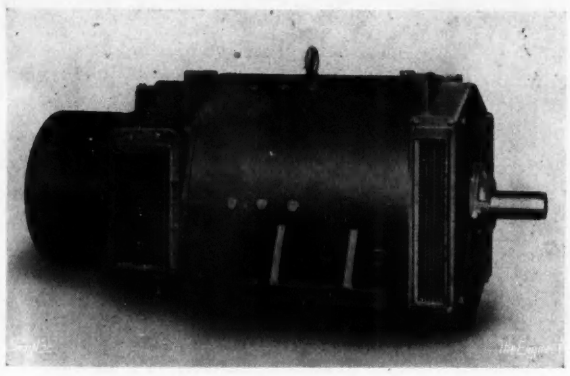


FIG. 16—COMPENSATED ALTERNATOR—MAWDSLEY'S

A. C. WICKMAN, LTD.

A variety of equipments for plastic welding, dielectric heating and induction heating can be seen on the stand of A. C. Wickman, Ltd., Coventry.

FIG. 17—5-kW DIELECTRIC HEATER—WICKMAN

An exhibit of some interest to those who are concerned with the speeding up of production processes involving rapid heating or drying is the 5kW high-frequency dielectric heater. One of the many uses suggested for this equipment is for drying china ware. For general drying operations the capabilities of this heater are demonstrated on the stand by a continuous belt of fabric which is passed through a tank of water and then into the machine, whence it emerges dry.

The equipment, which is illustrated in Fig. 17, consists of a self-contained unit incorporating two main components—a 5kW thermionic valve generator and a worktable. The generator comprises a valve oscillator with a built-in h.t., d.c. power unit and complete with main switch and interference suppressor. The "C" class oscillator uses a silica envelope valve and the tank circuit is adjustable by taps so that a wide variety of work can be matched with the anode of the oscillator valve.

The worktable is the heating chamber formed by the electrode plates. In the standard equipment these plates are 14in square and the gap between them can be adjusted up to a maximum of 6in by turning a hand wheel on the side of the heating chamber. A removable plate is fitted to the door so that a standard tray can be used, allowing small preforms, &c., to be tray-loaded.

When delivering an output of 5kW the mains loading is 9·4kW at a power factor of approximately 0·9. The generator is stated to be capable of delivering a continuous output of 5kW into the work at a frequency of about 6 megacycles. The power unit is suitable for connection to a 200/250V, single-phase, 50 cycles per second supply.

Meters and controls for the oscillator and worktable are conveniently grouped. The main fuses are housed on the rear panel and a mains voltmeter indicates the supply voltage. On the front panel of the equipment there is a h.t. voltmeter, an ammeter for the anode current, a trip-reset button and a h.t. standby switch. For controlling the high-frequency energy at the worktable there is an on/off push button, together with an indicating light, a power meter and a trip-reset button. Process timers can be fitted to suit individual requirements.

Another exhibit on the same stand serves to demonstrate the application of induction heating to tool tipping operations, using a 1kW induction heater for brazing "Wimet" tungsten carbide tips to turning tool shanks. Yet another demonstration shows the use of "Ardite" hard-facing rods for depositing a hard metal wear-resistant surface on steel or iron parts, which otherwise would have to be manufactured entirely from expensive alloys.

HANCOCK AND CO. (ENGINEERS), LTD.

A particularly interesting piece of equipment to be seen amongst the well-known range of oxygen cutting machines made by Hancock and Co. (Engineers), Ltd., Progress Way, Croydon, Surrey, is a portable machine which cuts holes to a developed shape in pipes. Known as the "Holecutter,"

it cuts holes with edges either vertical or at any angle up to 45 deg. It is particularly suitable for cutting holes in pipes prior to the welding in of branches. Holes up to 10in diameter in tubes or pipes from 4in to 12in diameter can be cut with the standard machine illustrated in Fig. 18. The machine is relatively light and is suited equally well for use in the field or in the workshop.

The main framework of the machine consists of a pair of vee supports connected to each other by spacer bars, each support having attached to it a chain and adjustable chain clamp for securing the machine to the tube. A flat annular carrier plate having two parallel outside edges is slidably mounted on guides on the flat tops of the vee supports. Adjustment of the carrier plate over the pipe enables holes to be cut either centrally or to one side of the centre line. The slides are graduated and the plate can be set up to 4in off centre to the pipe.

On top of each vee support and directly in line with the pipe centre line is a vertical column. At the top of each of these columns is a balanced, graduated arm mounted on a ball bearing pivot, and the ends of the arms are connected together by a round runner bar. The balanced arms are made adjustable for length so that the distance from the pivots to the centre of the runner bar can be set equal to the outer radius of the pipe to be cut.

A ball bearing mounted runner which is free to move from end to end of the bar carries a forked bracket also mounted on ball bearings. This bracket pivots centrally about the runner bar. In the centre of the bracket is a round ball bearing mounted bar projecting downwards at right angles to the runner bar.

Mounted on three vee guide wheels set on spindles projecting upwards from the carrier plate is a steel ring which is rotated by a hand drive geared to the outside edge of the ring. This ring driving unit comprises a gear-box driving, through worm and worm wheel and spur gears, two vertical spindles—one fast and one slow. Two interchangeable sprockets, one large and one small, are keyed to the spindles. The gear-box is arranged to swivel so that one or other of these sprockets meshes with a chain wrapped around the ring to form a rack. By using one or other of the sprockets on either spindle four ring rotating speeds are obtainable.

Fixed across the ring are two graduated parallel slide bars positioned at equal distances, one on either side of the centre line. A cross head is arranged to slide along these bars for setting the radius of the hole to be cut. Mounted slidably in ball bearings in this crosshead is a vertical stainless steel square tube. At the top this tube is clamped to the bar projecting downwards from the runner bar bracket. The bar is adjustable in the clamp and its free end passes through the end of the square tube. At the lower extremity of the square tube is a graduated vee slide on which the burner head is carried. The burner head nozzle can be swung from the vertical through an angle of 45 deg. When setting the machine, after the angle of the nozzle has been adjusted, the burner head can be slid back until the point of contact made by the oxygen jet with the pipe to be cut coincides with the centre line of the vertical round bar.

The burner is controlled by a valve unit which is bolted to the frame of the machine and connected by three rubber tubes to the head in which is incorporated the gas mixing injector.

The machine is automatic in operation because, since the distance from the pivots to the centre of the runner bar is equal to the outer radius of the tube, the centre of the runner bar must move through a path parallel with the outside curvature of the tube when the driven ring is rotated. The runner on the bar moving with the ring will also follow this path and, as the runner is mechanically coupled to the burner, this will follow the contour of the tube in any position within the capacity of the machine. The crosshead thus moves in a circular path with the burner following the combined circular and lifting movements.

On this stand can also be seen the "Aceta" low pressure acetylene generator, and the "Sight Feed" medium pressure generator, which are now being made under licence in this country by an associate firm, Weldcraft, Ltd. That company is also demonstrating the automatic "Gasfluxer," for bronze welding or brazing, which dispenses with the use of powdered flux. In this apparatus the fuel gas is passed through a small fluxing apparatus where it picks up gaseous flux, which is fed to the work through the flame.

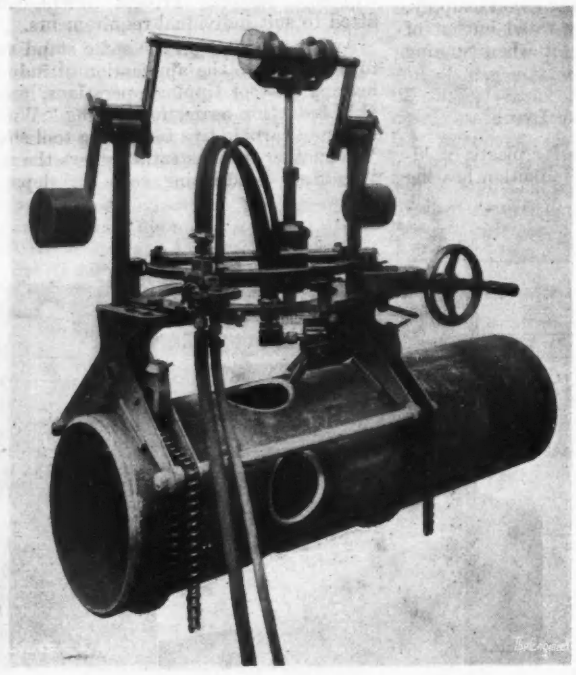


FIG. 18—HOLE CUTTING MACHINE—HANCOCK

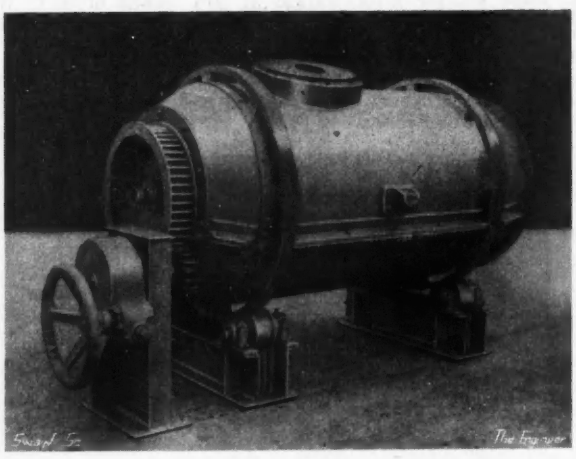


FIG. 19—ONE-TON, SEMI-ROTARY TILTING FURNACE—MONOMETER

MONOMETER MANUFACTURING COMPANY, LTD.

The preheated-air central axis tilting furnace on the stand taken by the Monometer Manufacturing Company, Ltd., "Barton Towers," Clifton Drive, Westcliff-on-Sea, Essex, is an example of the design of furnaces built by the firm for the melting of brass, bronzes, gunmetal, light alloys, &c. These furnaces are built in sizes ranging from 250 lb to 1500 lb brass capacity and the one exhibited, which is illustrated in an accompanying engraving, Fig. 20, has a capacity of 600 lb. Firing is effected by means of oil or gas burners working in conjunction with a preheated air system, designed to give economy in fuel and rapid melting conditions. Melting takes place in totally enclosed conditions and this system of enclosure combined with preheated air gives an increased thermal efficiency to the furnace.

The furnace body is of all-welded steel plate construction and is lined throughout with high alumina firebricks backed with insulation material. The body is carried on 3in diameter mild steel trunnions mounted on self-supporting pedestals, and tilts from a centrally disposed axis. Tilting is effected by a hand wheel through totally enclosed oil-immersed gears.

A non-crucible semi-rotary tilting furnace, illustrated in Fig. 19, and shown on the stand, is built in brass capacities from 1000 lb to 3 tons.

These furnaces, which have been primarily designed for the melting of gunmetal, brass, bronze, aluminium, &c., can be fired either by means of oil or town's gas and require air to be supplied by a fan at a pressure of about 1 lb per square inch. Primarily the furnace consists of a cylindrical body supported in a horizontal position and arranged to be capable of rotation about its axis. The burners are placed centrally at each end, their opposed flames thus producing a reverberating blanket of incandescent heat over the entire surface of the metal. With this arrangement fuel consumption per ton of metal melted is stated to be very low, whilst melting times

are correspondingly short. At intervals during melting, the furnace is rolled over from one side to the other and the metal within is brought into contact with that part of the furnace lining which has been subjected to the full heat of the burners, greatly to accelerate the speed of melting.

The furnace body is built up of heavy steel plates with conical ends and is tilted

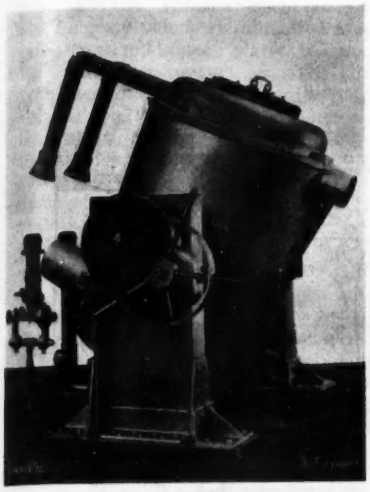


FIG. 20—TILTING CRUCIBLE FURNACE—MONOMETER

by means of a rack and pinion wheel. The body is supported on pedestals carrying rollers mounted on ball-bearing plummer blocks, giving ease of rotation and precise control of pouring. It is heavily lined throughout with high alumina firebricks, suitably insulated, or it can be ram-lined with a high quality refractory.

It is claimed by the maker that this type of furnace has many advantages as there are no crucible costs, whilst the necessity for relining only occurs after long periods of service.

BUTTERS BROS.

Among the models of cranes designed for use in the shipbuilding and other industries, to be seen upon the stand taken by Butters Bros. and Co., Ltd., of Glasgow, is one of the new travelling shipyard monotower cranes.

These cranes are normally designed with a capacity of 15/20 tons, as this was found to be about the maximum lift required in shipyard work. As this monotower crane is of the all-revolving, self-travelling type, and has a jib 127ft 6in long, it is able to command a large area. It is designed to travel on approximately 25ft rail tracks, but can also be fixed in permanent concrete foundations.

The 15-ton crane with a 127ft 6in jib lifts the full load of 15 tons at 90ft radius, and lighter loads of 6 tons at 126ft radius, the speeds of operation being 15 tons at 30ft per minute in hoisting, or 6 tons at 100ft per minute in hoisting; 15 tons at 40ft per minute in luffing; 15 tons at 75ft per minute in travelling; and 15 tons at 300ft per minute in slewing. It is also fitted with a fast auxiliary lift of 1½-ton or 3-ton capacity, operating at 100/150ft per minute at any radius.

In shipyards these monotower cranes, which are made in all capacities and with varying lengths of jib by the firm, are generally placed on tracks between the slipways. They are also used extensively on the dock-sides, graving docks and fitting-out basins, where their particular design, combining great working radius and long height of lift and high clearance prove very effective.

BIRLEC, LTD.

The exhibits displayed by Birlec, Ltd., Erdington, Birmingham, demonstrate some of the possibilities of high-frequency induction heating applied to heat treatment as well as to melting.

One of the equipments on view is the latest type of Birlec rocking-arc electric melting furnace. This class of furnace, which is built in capacities ranging between 10 lb and 1000 lb, is claimed by the maker to give exceptionally rapid melting with close metallurgical control in brass and iron foundry work, particularly in the production of complex ferrous or non-ferrous alloys. The example exhibited is the "LFY" furnace, which has a capacity of 500 lb and is generally similar to the equipment illustrated in Fig. 21, except that the latter has a capacity of 1000 lb.

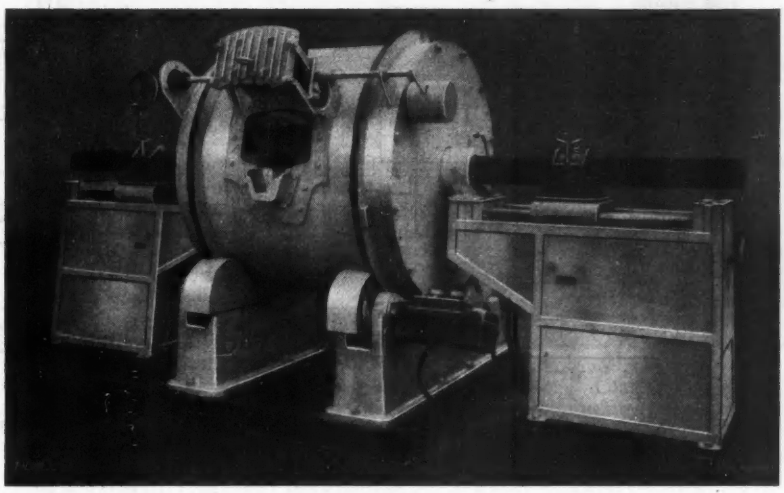


FIG. 21—1000 LB. ROCKING ARC MELTING FURNACE—BIRLEC

In this class of furnace the refractory-lined melting chamber is built in a substantial steel casing which is supported with its axis horizontal on rollers carried by heavy base pedestals. The furnace is charged through a door opening on the mid circumference, a pouring spout being incorporated in the lower sill; a close-fitting refractory-faced door makes the chamber virtually air-tight during melting. A graphite electrode enters the chamber on the axis at each end, an arc gap being left between the electrodes in the centre of the chamber. Energy for the arc is supplied to the two electrodes through a power transformer.

The mounting rollers are connected through heavy reduction gearing to a reversing electric motor controlled by a rocking cycle regulator whereby the furnace is oscillated about its axis in such a way that the regulator increases the amplitude of oscillation as melting proceeds. This important characteristic brings the furnace charge rapidly into contact with all parts of the heated furnace lining and greatly accelerates the rate of melting. Furthermore, this rocking action serves to stir the molten bath and to prevent local overheating. Meters for measuring the input power to each charge are mounted on an instrument panel, so that the charge temperature can be closely estimated.

Heat treatment equipment is represented on the same stand by a Birlec "RP 20" general purpose furnace of the kind that is useful for such operations as annealing, carburising, hardening and tempering in tool rooms or in small-scale production shops. Completely automatic temperature control is provided and a heating element is fitted on the inner face of the door to neutralise front losses and to ensure uniform heating throughout the furnace chamber. This furnace, which is demonstrated in operation, has chamber dimensions of 24in by 12in by 8in. Larger furnaces of similar design are available in the standard range up to approximately 5ft by 3ft by 1ft 6in and other sizes can be made to order.

BLACK AND DECKER, LTD.

The familiar range of portable electric tools displayed upon the stand taken by Black and Decker, Ltd., Harmondsworth, Middlesex, includes the "Ripsnorter" saw, illustrated in Fig. 22. This saw is made in two sizes with 7in and 9in diameter blades

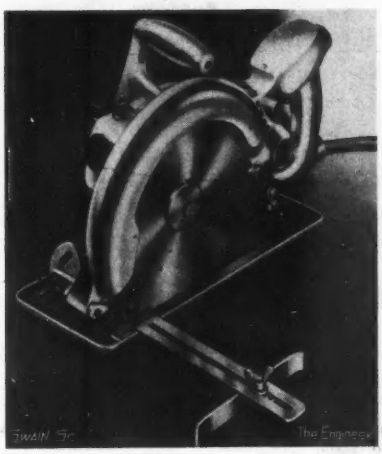


FIG. 22—PORTABLE ELECTRIC SAW—BLACK AND DECKER

designed for depths of cuts up to 2⅜in and 3⅛in, respectively.

The saw motor has a light, rigid aluminium housing, to which a table is clamped at the

front and rear. The position of the motor and saw spindle in respect to the table can be quickly adjusted through a nut to vary the depth of cut. The motor drives the spindle through helical steel worm and worm-wheel and the spindle with its saw can be adjusted through an angle of 45 degrees by means of a wing nut on a bracket at the side of the motor housing. Sub-

water pipes, guttering, stones, marble, slate, &c.

Stothert and Pitt, Ltd.

An interesting exhibit on the stand of Stothert and Pitt, Ltd., of Bath, is a variable delivery, rotary displacement, piston pump, which has been designed for the purpose of handling oils of varying viscosity. This

shaft carries with it the cylinder, which in turn drives the pistons. Each piston has an axis of rotation similar to that of its bearing, which is mounted on the crankshaft, but eccentric in relation to the cylinder; this causes a movement of the pistons in their bores and gives them a length of stroke equal to twice the degree of eccentricity. Output is varied by altering the

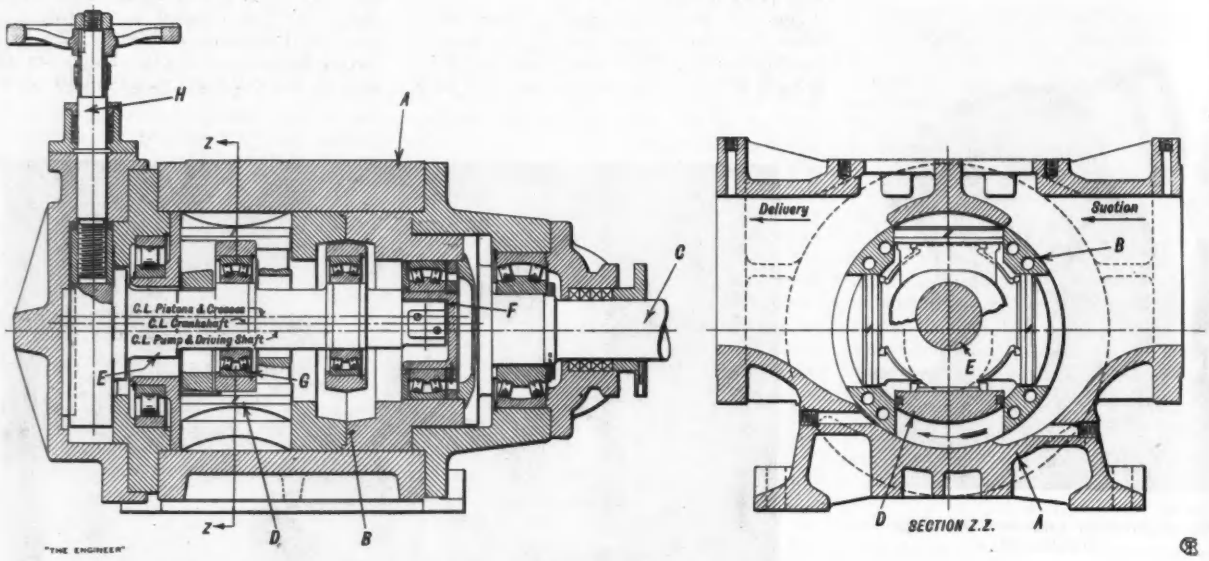


Fig. 23—Sectional Arrangement of Variable Delivery Oil Pump—Stothert and Pitt

stantial guards round the saw serve to protect the operator and, as the saw penetrates the work, the lower guard telescopes into the upper guard.

In addition to the standard rip and cross-cutting saw blades others are now supplied for cross cutting to give a better finish than the combination blade. A planer blade which can be fitted will give both cross cut and rip sufficiently smooth for immediate glueing. A nail-cutting blade also supplied is suitable for use in cutting out old flooring or for ripping apart large cases where it is found

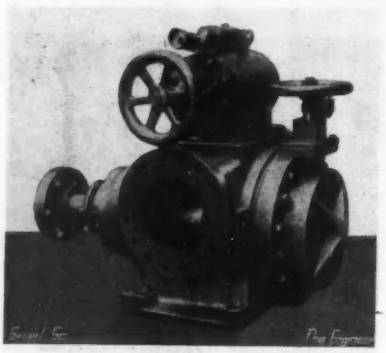


Fig. 24—Variable Delivery Pump—Stothert and Pitt

easier to cut the case rather than to draw the nails.

A fine-tooth blade can be used for cutting all non-ferrous metals in sheet form, such as lead, copper, zinc, aluminium and various softer alloys, and a friction blade for cutting corrugated iron. In addition to these blades, the saw can be provided with an abrasive disc which will cut bricks, tiles, cement asbestos, cast iron drain pipes,

pump's output can be varied from nil to maximum, according to the viscosity conditions of the liquid being handled, and output adjustments can be made when the pump is either running or is stopped.

The construction of the pump can be seen in the drawing we reproduce in Fig. 23, and a photograph in Fig. 24. Within the body A there is carried on roller bearings a rotating hollow cylinder B, directly coupled to the driving shaft C. The cylinder has eight holes bored in its walls, the holes being diametrically opposed in pairs. In each bored hole is a piston D directly coupled to its opposite member by means of a hollow sleeve through which passes the crankshaft E. This crankshaft is eccentric in relation to the cylinder and twice the degree of eccentricity constitutes the stroke of each piston in its cylinder bore. The crankshaft, which does not rotate with the cylinder, is supported on a stationary plain bearing F within ball bearings at the inner end of the cylinder. Each bank of pistons have their internal faces bearing against a cross member which is mounted on ball bearings G on the crankshaft. The degree of eccentricity of the crankshaft within the cylinder is adjustable through a plate. This plate slides between bronze inserts in the end cover, and its position is controlled by the spindle H fixed to the top of the plate.

In operation the rotation of the driving

piston stroke and is effected by turning the output regulating hand wheel. The regulating spindle, through its plate, raises or lowers the crankshaft in the cylinder to increase or decrease the degree of eccentricity with a consequent variation in output, which is reduced to zero when the degree of eccentricity is nil.

The pump is generally supplied with a relief valve in order to allow full output to be by-passed from the discharge to the suction side of the pump to safeguard it against unexpected closure of the valve on

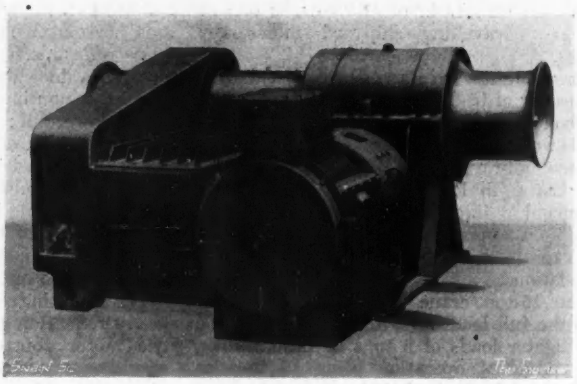


Fig. 25—Electric Cargo Winch—Stothert and Pitt

the delivery side. The pump is designed to render pre-heating of the oil being pumped unnecessary. A pointer on a graduated scale can be fitted to give an indication of output for any given position of the control hand wheel.

An electrically-driven geared cargo winch is made by the firm in two standard sizes of 3-ton and 5-ton capacity at speeds from 80ft to

120ft per minute. With these winches, one of which is illustrated in Fig. 25, half loads are lifted at twice the full load speed and a light hook at about 450ft per minute. The machines are designed to combine reliability under hard and continuous working in all climates with compactness and lightness consistent with strength.

Each winch is a self-contained water-tight unit requiring only connection to the power supply. The bed, worm gear case and control gear casings are fabricated as a single unit from mild steel plates to produce a light but strong structure. The contactor type control gear embodies the usual no-volt and overload features, both necessitating the return to the "off" position before the winch can be restarted. Under normal conditions quick reversal does not cause damage to the electrical gear. The contactors are built in the panel housed in a casing formed with the winch bed and the complete unit can be quickly exposed by the removal of the casing cover. An externally operated isolating switch is incorporated in the panel. The resistances are also housed in a water-tight casing and the commutator and magnetic brake are enclosed behind large doors.

A compound-wound motor, which is liberally rated for working normal cargo continuously, is flange mounted to the worm gear casings. The worm wheel rim is of centrifugally cast phosphor bronze and the worm shaft is of 55-60 tons tensile forged steel. Both are machine cut and the worm shaft is ground on the threads, bearing surfaces, &c. The gearing runs in oil and all shaft bearings are self-lubricating. All the brakes, which are totally enclosed and water-tight, have large wearing surfaces and a hand release is fitted to the magnetic brake.

TECALEMIT, LTD.

A wide selection of its extensive range of automatic, semi-automatic and manually-operated lubricating equipment is to be seen upon the stand taken by Tecalemit, Ltd., Great West Road, Brentford, Middlesex. A new range of the well-known "Brentford" lubricators is based on the original design and incorporates several interesting features.

In the new design the principle of unit construction is followed, each lubricator being built on the basis of a pump body assembly, and an oil reservoir. Of these basic components the pump body assembly can have from one to twenty pumping units and the oil reservoirs are made in three sizes, holding one, three or eight pints.

To these units many be added a gear-box, oil-flow indicators, a drive component and an oil lift as required. The gear-box can be of the detached or the integral type, and the drive component can be in the form of a coupling, pulley or chain wheel for rotary drive, or a ratchet arm for a reciprocating drive.

The twenty unit lubricator illustrated in Fig. 26 has illuminated rising drop indicators, on each of which is a destination label corresponding to the individual pumping unit from which it is supplied, and a description of the bearing or point which it feeds.

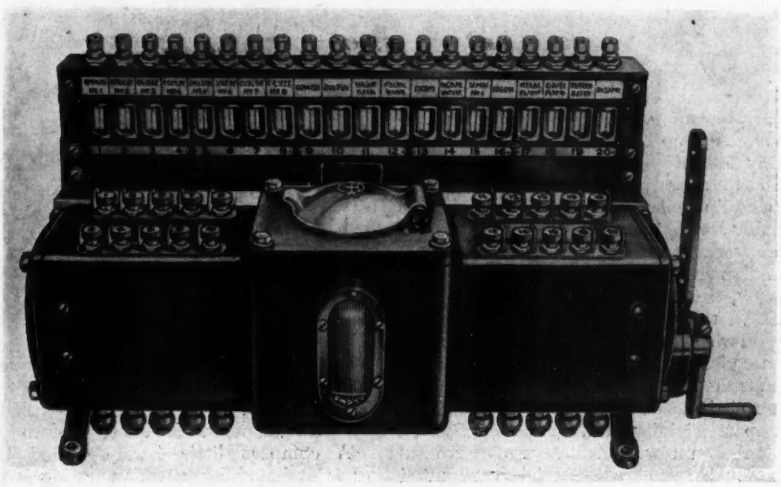


FIG. 26—TWENTY UNIT LUBRICATOR—TECALEMIT

METAFILTRATION COMPANY, LTD.

Filters of various sizes for air, water, oil and plating solutions are exhibited by the Metafiltration Company, Ltd., Belgrave Road, Hounslow, Middlesex. A typical water filter, such as is illustrated in Fig. 27, consists basically of a cylindrical chamber, into which the dirty or impure liquid is introduced at a pressure of from 10 lb to 100 lb per square inch, and forced through tubular filtering elements or packs. Suspended impurities are deposited on the outer walls of the element and the filtered water passes on up through a central chamber to the outlet pipe.

Each of the filtering elements consists of a column of Monel metal, gunmetal or stainless steel rings with larger diameter brass rings interposed at $\frac{1}{4}$in intervals. In the smaller filters these elements are covered with brass gauze, but in the larger filters, delivering from 500 to 12,000 gallons per hour, they are left uncovered. Prior to the introduction of the liquid to be filtered a specified amount of a powder known as "Metasil" mixed with a small amount of water is deposited in the main chamber. When the water supply is turned on, this powder is picked up and deposited on the pack, where it forms an even coating over the whole of the element. Once in position, the powder provides an extremely fine labyrinth, which arrests all materials in suspension, while allowing the filtered water to flow through freely.

As long as the water pressure is maintained the filter bed formed by the powder is retained on the rings of the elements, but when the filter is out of action the bed falls away into a sump at the base of the body. In the case of the smaller capacity filters with gauze covered elements an inner filter bed is retained, whilst the dirt and powder on the outside of the bed falls. In the larger capacity filters the whole of the filter bed with the collected impurities drops on to the sloping floor of a sump and out through a sludge door. Complete cleaning can be effected by flushing the filter with clean water in the reverse direction, or the head of the filter, to which the packs are attached, may be removed and washed.

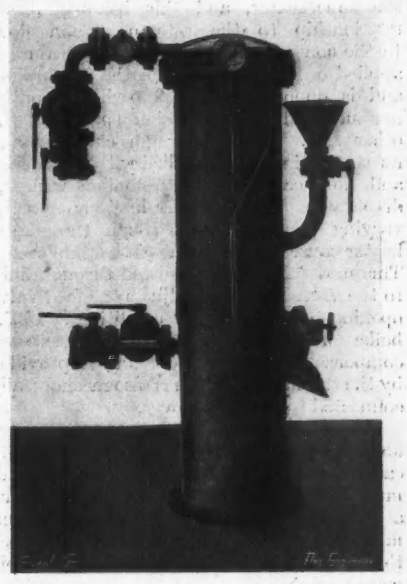


FIG. 27—WATER FILTER—METAFILTRATION

COPES REGULATORS, LTD.

An interesting exhibit on the stand of Copes Regulators, Ltd., 9, Southampton Place, London, W.C.1, is the "Flowmatic" marine type regulator, which is intended to control automatically the supply of feed water to boilers within close limits, according to the steam flow. It is designed to ensure accurate and dependable feed-water control in boilers handling wide load fluctuations.

The apparatus, to be seen in the drawing reproduced in Fig. 28, consists of a controller working the feed-water regulating valve in conjunction with a tension type thermostat. The controller is operated by the steam flow and the thermostat by the variation of the water level in the boiler.

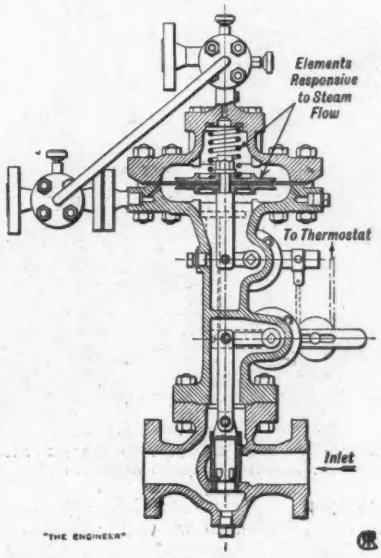


FIG. 28—"FLOWMATIC" REGULATOR—COPES

In the "Flowmatic" valve the element responsive to variations in steam flow is integral with the valve itself. The actuating principle is a spring-loaded rubber diaphragm which works from the pressure loss through the superheater, and this bears a direct relationship to the rate of steam flow. In the controller the boiler drum pressure is applied on the lower side of the diaphragm, and is opposed by the superheater outlet pressure and a compression spring on the other side. The diaphragm chamber and its connecting lines are filled with condensate and no steam comes into contact with the diaphragm. As the boiler load changes the varying pressure loss through the superheater causes a movement of the diaphragm. This movement is transmitted through links to the valve lever and adjusts the feed valve opening to the new flow conditions. If the boiler water level changes the necessary compensation of valve opening is provided by the thermostat, which is also mechanically connected to the valve lever.

Adjustments can be made to the valve lever so that the regulator can be set to carry a level slightly below normal at minimum load, and a level slightly above normal at full load. This means of adjustment minimises the possibility of carry over when the engines are being used during rapid manœuvring.

LAWES RABJOHNS, LTD.

The drawing-office equipment made by Lawes Rabjohns, Ltd., Abbey House, Victoria Street, London, S.W.1, includes the "Paramount" drawing stand fitted with the "Admel" draughting machine, illustrated

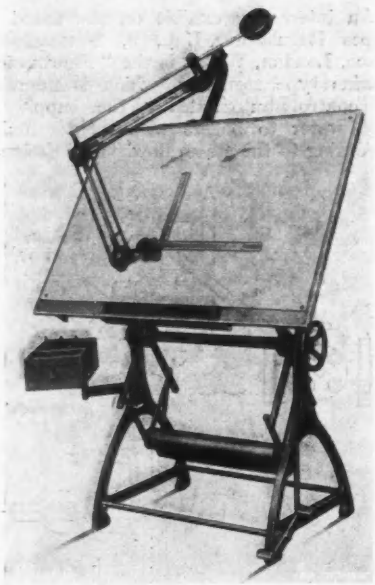


FIG. 29—DRAWING STAND AND DRAUGHTING MACHINE—LAWES RABJOHNS

in Fig. 29. The board itself is fixed to a rigid angle iron frame, to which the draughting machine is directly attached. This method of construction relieves the board of strain and avoids any risk of its warping. By means of a pedal the board can be smoothly and easily adjusted to any required height or inclination from horizontal to vertical. The board also has a vertical movement for a given fixed angle of inclination.

The design of the "Admel" draughting machine is such that each parallelogram consists of an endless spring steel band passing over two large diameter pulleys at the knuckles of the machine. The two pulleys are of exactly the same diameter, so that rotation of one gives exactly the same rotation to the other. The two pulleys at the knuckle joint are, in fact, one, and so the pulley at the fixing point being fixed rotationally, the one carrying the protractor head must maintain its rotational position wherever the head is moved over the drawing board. It will be appreciated that this method is equally efficient whatever the position of the protractor head.

The machine is light and free in movement, the pulleys and their housings are light alloy die castings of ample section to combine rigidity with strength. Metal tubes, which are used to connect the pulley housings, can be adjusted for length to control the tension of the spring steel bands.

E. H. JONES (MACHINE TOOLS), LTD.

An interesting display of power presses, precision measuring instruments and general workshop equipment has been arranged on the stand of E. H. Jones (Machine Tools),

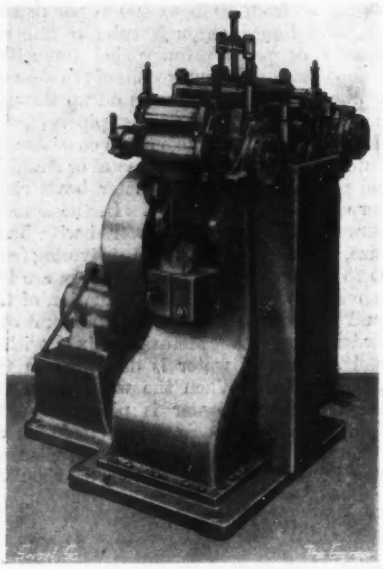


FIG. 30—"C.V.A." DIEING PRESS—E. H. JONES

Ltd., Edgware Road, The Hyde, London, N.W.9. A majority of the instruments have already been dealt with in our columns and will be familiar to readers, but some of the press equipment displayed by the firm is probably less well known.

The working exhibits include some of the "Unit" range of presses from 25-ton to 40-ton capacity, fitted both with and without roll feed. In these presses the heavy cast iron base, on which the frame is mounted, encloses the electrical gear and forms a useful receptacle for the tool kit. The frame is fabricated from rolled steel sheet and is proportioned to impart rigidity and reduce deflection to a minimum without the use of frontal tie bars. On the frame is rigidly mounted a series of units comprising self-contained sub-assemblies of the press-actuating mechanism. Each unit is designed and built to close limits to permit the rapid interchange of parts and reduce loss of time on maintenance. Safety guards, although readily removable, are an integral part of the control mechanism and their operating mechanism is interlocked with the clutch gear. The control gear is totally enclosed and can be set by means of a small selector lever to give continuous slide movement or single non-repetitive strokes. When set in a third position the lever locks the control gear in a safe position. Means of adjustment are incorporated in the clutch to permit fine dead-centre stepping of the driving shaft, and if roll feed is needed a drive may be coupled to the end of the shaft which projects through the control box cover.

Fine adjustment for tool height on the slide is provided by an Acme thread screw encased within the slide and retained in a fixed sleeve to overcome any offset loading resulting from connecting-rod angularity.

A new "C.V.A." dieing press is made in two models of 10-ton and 25-ton capacities. We reproduce in Fig. 30 a photograph of the smaller machine which is designed to make 300 working strokes per minute. It has a fixed stroke of $\frac{1}{2}$in which is set by the throw of the crankshaft, but if required the machine can be fitted for special strokes of from $\frac{1}{4}$in up to $1\frac{1}{4}$in. A double pedal control can be set for single-stroke or continuous running conditions. An automatic roll feed incorporates simple means of adjustment for various lengths of feed and pressure between the rollers. Brakes with automatic release mechanism are fitted to the lower roll shaft to prevent over travel with each motion. The whole of the roll-feed mechanism can be swung at right angles clear of the bolster plate when the machine is being set. The feed mechanism also incorporates an oil bath and felt roller which lubricates the strip before it enters the tool. Synchronised with the roller feed is an adjustable cropping attachment.

The machine has a die bed 14in square with a 5in by 4in opening, and the distance from the bolster to the upper head with the stroke and adjustment up is 8in. Strip up to

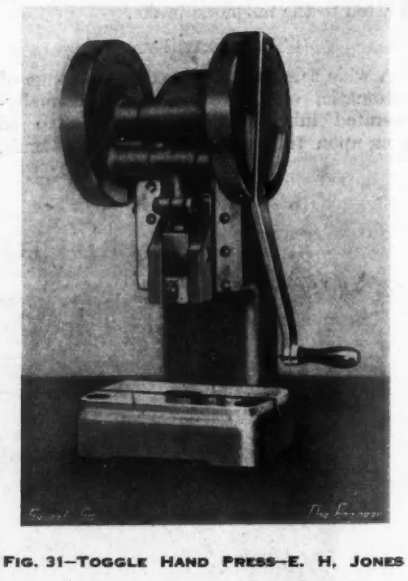
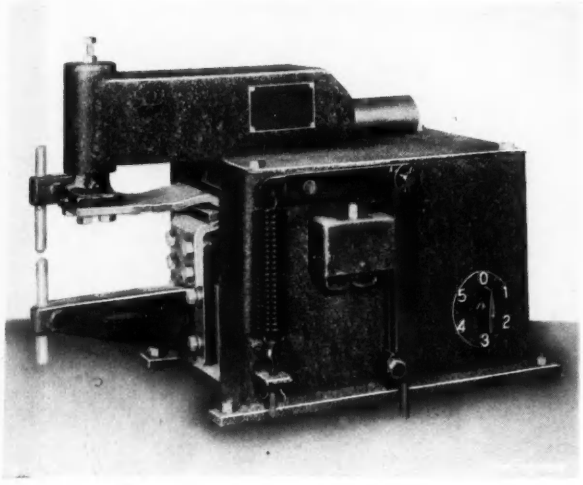


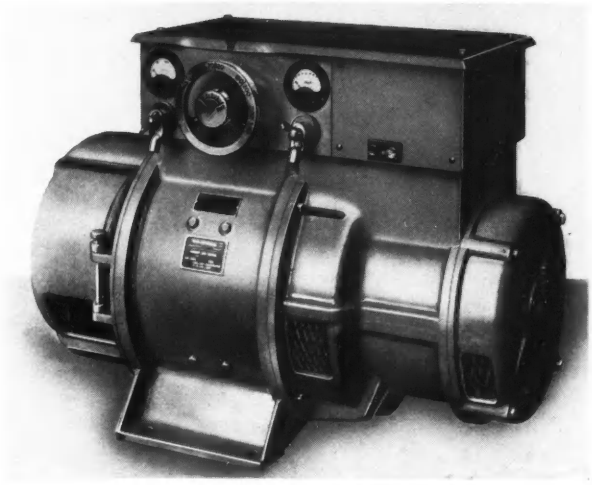
FIG. 31—TOGGLE HAND PRESS—E. H. JONES

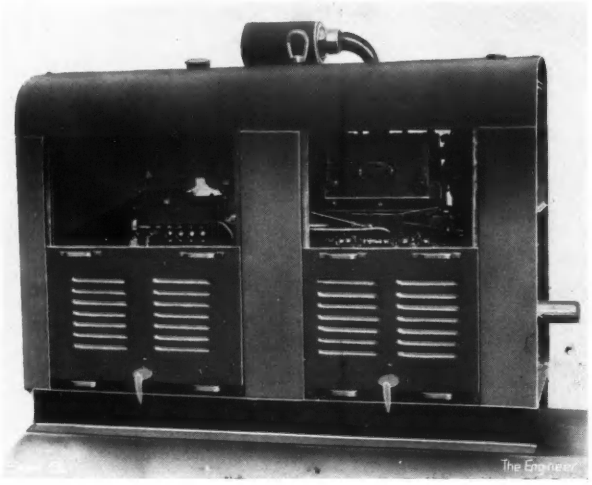
5in wide can pass through the roll feed, which is designed to feed lengths of up to 4in.

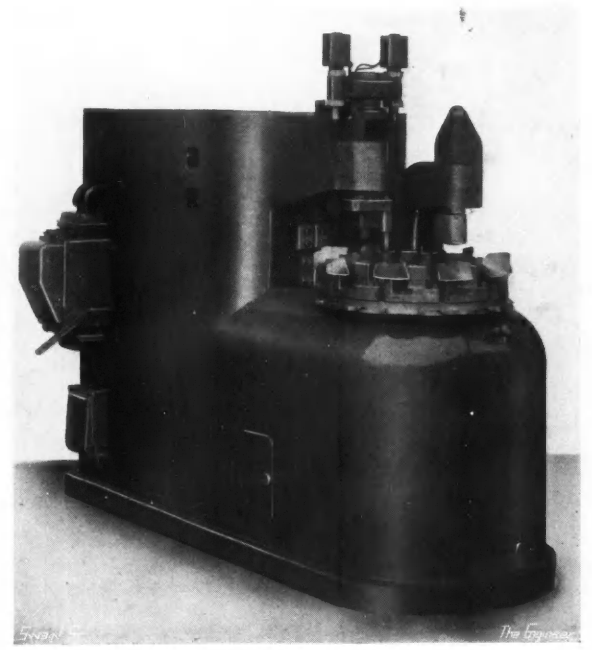
A compact little hand-operated toggle press designed for bench mounting is made by Smart and Brown, Ltd. This press, illustrated in Fig. 31, is made in two sizes with capacities of 1 and $2\frac{1}{2}$ tons. In its rigid main frame a machined Meehanite ram moving in hardened and ground slides is actuated through a hand lever by a heavy toggle link. Ram stroke adjustment is effected through a threaded toggle link pin, the length of adjustment on the smaller machine being 1in and on the larger machine $1\frac{1}{4}$in. The working stroke of the ram is made by the movement of the handle through an angle of 40 deg. and is $\frac{7}{8}$in long on the smaller and 1in long on the larger machine.

WELDING EQUIPMENT AT THE OLYMPIA EXHIBITION









4 - KVA BENCH SPOT WELDER—SIEMENS - SCHUCKERT

MOBILE DIESEL - ELECTRIC ARC WELDING PLANT—MUREX

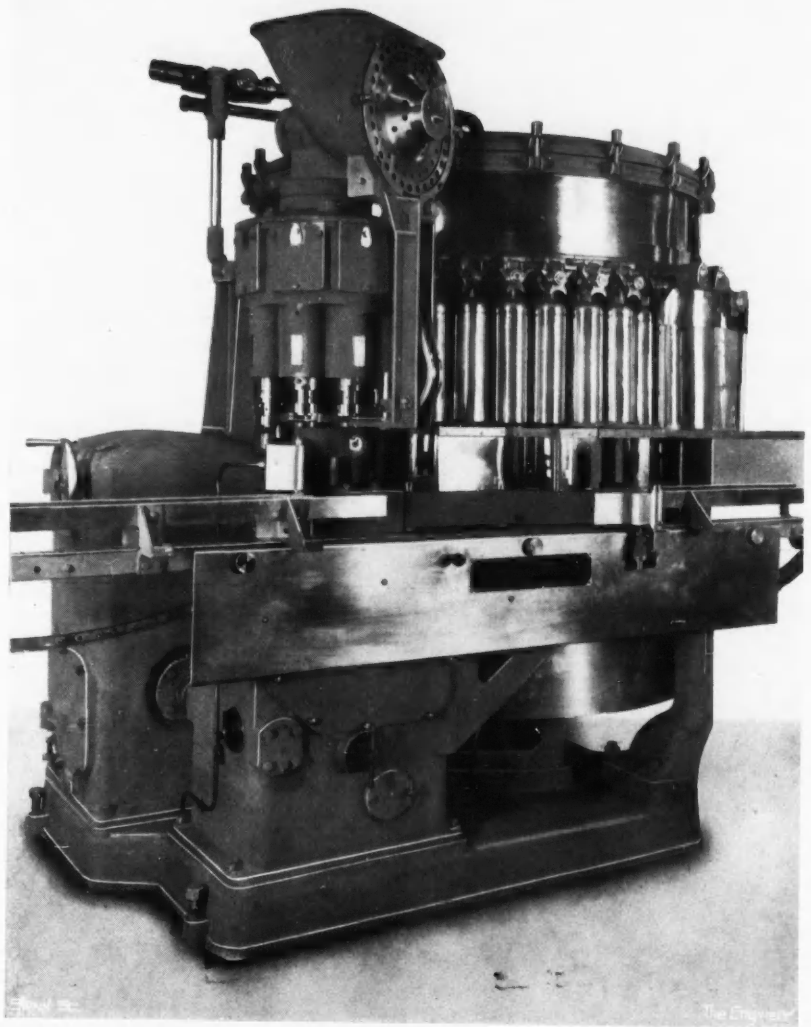
CAPACITANCE STORAGE SPOT WELDING MACHINE—PHILIPS

300 - A A.C./D.C. WELDING SET—REYROLLE

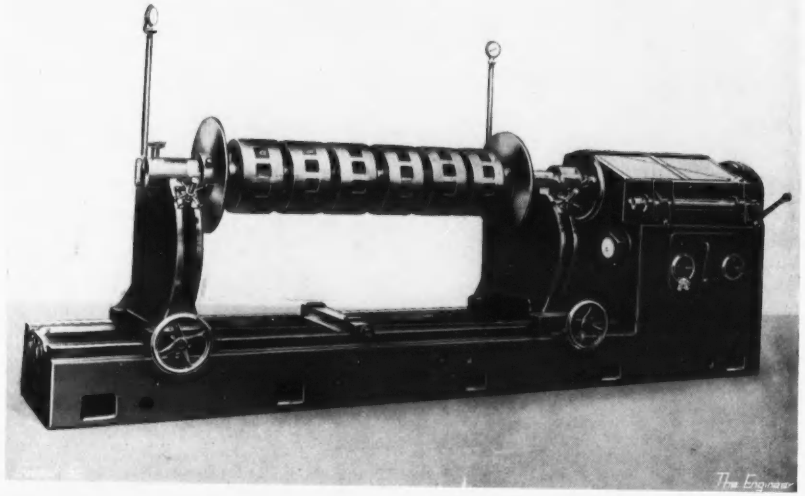
DIESEL - ENGINE DRIVEN WELDING SET—QUASI - ARC

AUTOMATIC INDEXING PROJECTION WELDER—SCIAKY

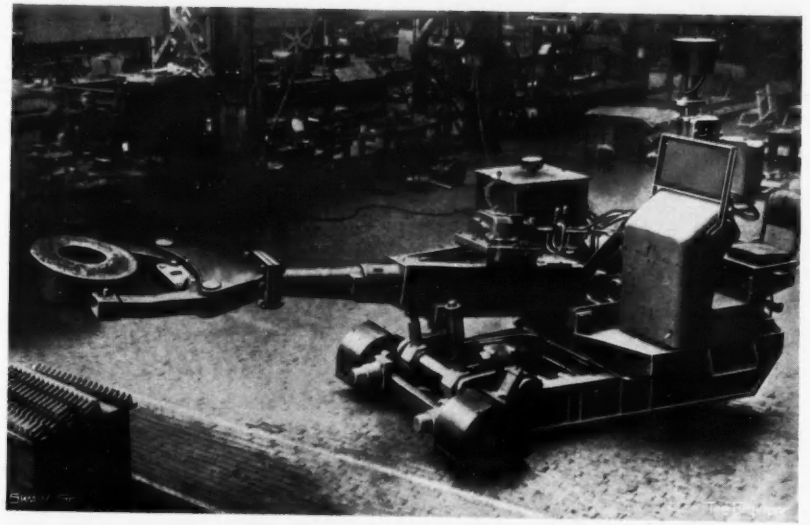
INDUSTRIAL EQUIPMENT AT THE OLYMPIA EXHIBITION



"SUPER-FORTY" BOTTLE FILLING AND CROWN CORKING MACHINE—VICKERS-ARMSTRONGS

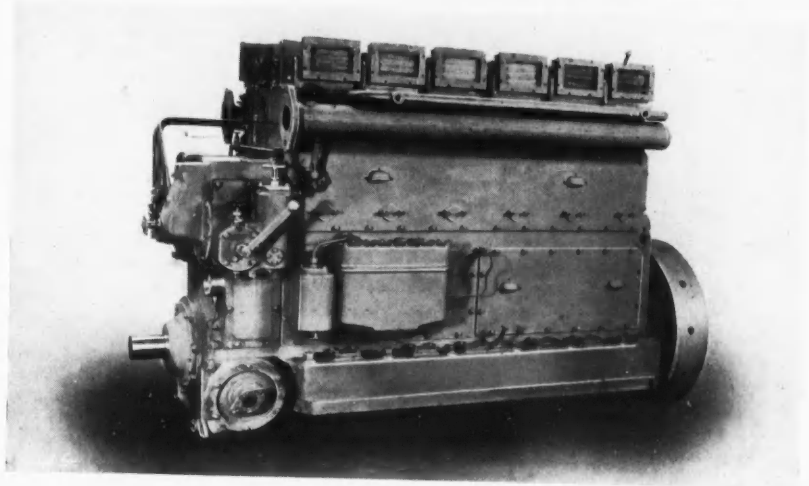


DYNAMIC BALANCING MACHINE—AVERY

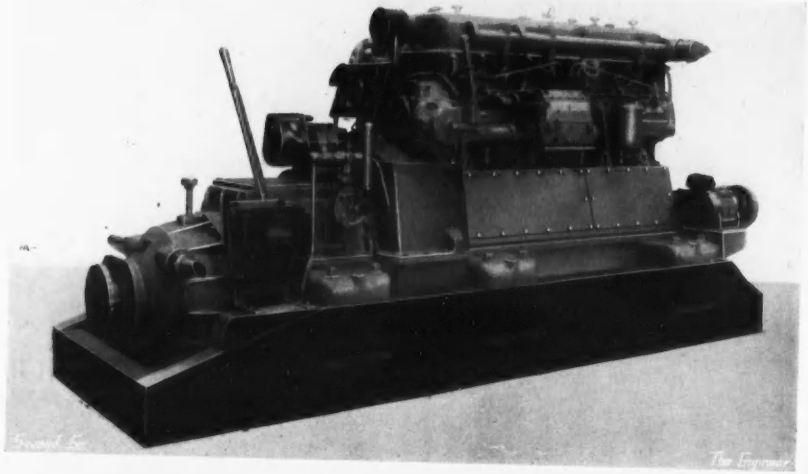


1-TON MOBILE TYRE CHEESE HANDLING MACHINE—WELLMAN

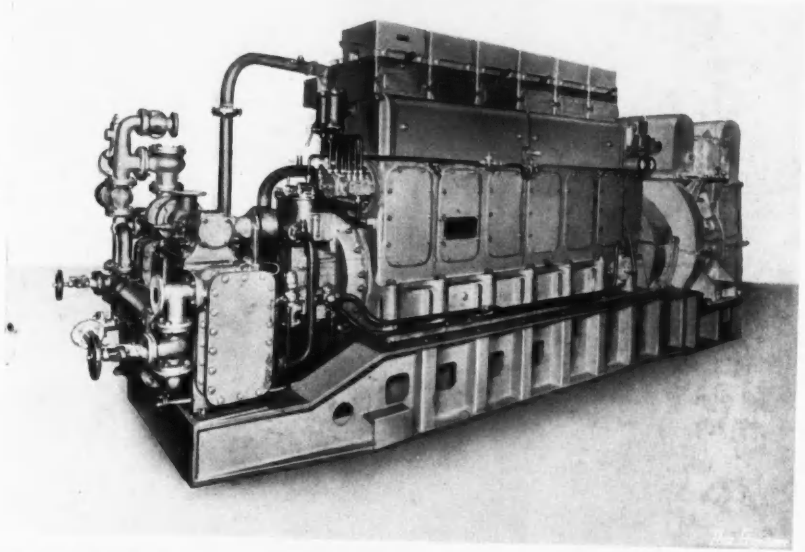
OIL ENGINES AT THE OLYMPIA EXHIBITION



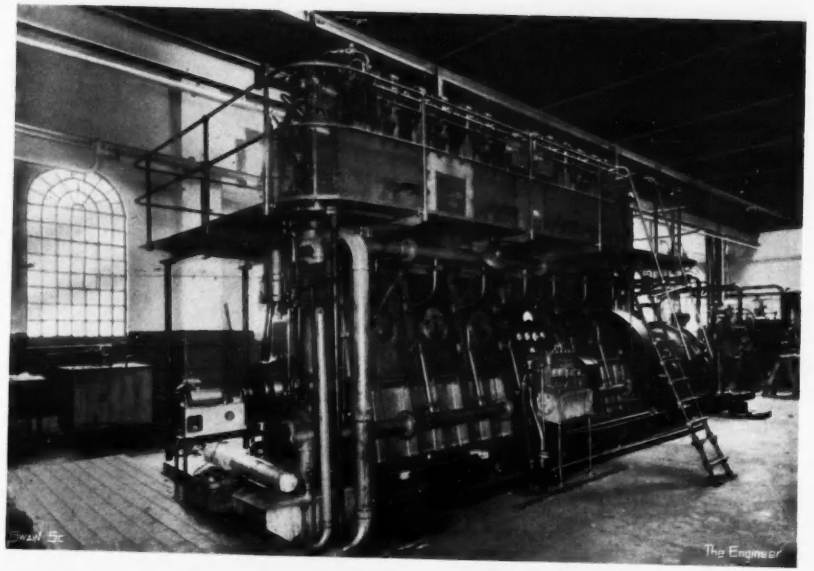
"M4AM6" SIX-CYLINDER, 220 B.H.P. ENGINE—NATIONAL GAS AND OIL 200-KW MARINE GENERATING SET—ENGLISH ELECTRIC



"MANK" 5 R.W.M., 1140 B.H.P. MARINE ENGINE—DAVEY, PAXMAN



"VOX" 1610 B.H.P., MARINE ENGINE—RUSTON



A Seven-Day Journal

Engineering and Marine Exhibition Inaugural Luncheon

At the inaugural luncheon of the Engineering and Marine Exhibition at the Olympia, on Thursday, August 28th, Mr. A. V. Alexander, the Minister of Defence, said that the exhibition showed creditable enterprise on the part of British industry. A great effort had been made by the many firms which were showing their products and these exhibits were worthy of the great reputation this country has in the engineering and marine world. Mr. Alexander pointed out that the exhibition gave no indication of a country which was expiring, but rather a proof that it was rapidly recovering from the stress of war. The very quality and range of the exhibits alone showed that our industry was in good shape. He then pointed out that the output of coal was the measure of the prospects of this country and upon the increase of this output the future of industry depended to a very great extent. In conclusion, the Minister expressed gratitude to industry for its efforts during the war and called upon it to put forward still greater efforts in the present crisis. In his response, Lieut.-Col. Lord Dudley Gordon, the President of the exhibition, said that the task of all engineers was to be ingenious and the present difficulties facing the engineers of this country should prove a spur as did the difficulties which their predecessors had to overcome in their time. Lieut.-Col. H. Riggall, the President of the British Engineers' Association, protested against the growth of centralisation. Although industrialists agreed there was need for some controls they felt that there was too much centralisation for efficiency. A broad directive was required from the Government and industry should be left alone to get on with the job.

The Industrial Wales Exhibition

The Industrial Wales Exhibition in the Empire Hall of Olympia, London, which was opened on Thursday, August 28th, by Lord Portal, will be open daily until Saturday, September 13th. This exhibition has been promoted by the Industrial Association of Wales and Monmouthshire, a new body, formed by the amalgamation of the South Wales and Monmouthshire Industries Association and the North Wales Association of Industries. It has been arranged mainly to demonstrate the wide variety and successful progress of new manufacturing activities in Wales, against the background of the older basic industries of coal, steel and tinplate, and the characteristics and culture of the Welsh people. Heavy industries are represented by coal, steel, tinplate, shipping, chemical and quarrying interests, and the exhibits of engineering equipment and products are particularly varied. A representative selection of the goods made by the lighter industries include nylon, textiles and hosiery, tweeds, footwear, jewellery, clocks, optical accessories, &c. Domestic articles made in the area are illustrated by the range of furniture, lighting fittings, radio receivers, refrigerators, hollow ware, wringers and washing machines, &c., shown upon the various stands. In addition to the exhibits on individual stands, various bodies have collaborated in preparing interesting demonstrations to illustrate the background and general aspects of the principal industries and national features by means of models, pictures and working exhibits.

Jet Aircraft Progress

On Sunday, August 31st, at the air races arranged by the Cinque Ports Flying Club, at Lympne, Kent, Group Captain John Cunningham, the chief test pilot of the de Havilland Aircraft Company, set up an international closed circuit record for aircraft of any power by averaging a speed of 496.88 miles per hour over 100km. He was flying a D.H. "Vampire" jet-propelled fighter. The existing record was set up in 1946 by Lieutenant R. Baird, of the United States Flying Force, who was then flying a Lockheed "Shooting Star," jet-propelled fighter. On Monday, September 1st, a short flight was made from Hatfield to London and back in a Lancastrian four-engined air liner, in which the two outboard Rolls-Royce "Merlin" piston engines had been replaced by de Havilland "Ghost" gas turbines. This turbine, which gives 5000 lb static thrust on the test bed, has a present output in flight of about 4500 lb. The intention is to increase its output to the test bed figure and to lengthen the period required between engine overhauls. The results obtained will, it is expected, be of great value in preparing for the use of "Ghost" turbines in the D.H. "106," aircraft now under construction at Hatfield. The "Lancastrian" took off with all four prime movers, the two "Ghost" turbines, and the two "Merlin" engines, in operation. When height had been gained the two inner "Merlin" engines were cut out and their airscrews placed in the feathering position. There was a noticeable diminution of noise and no vibration was felt with the turbines alone in operation. When landing, the two "Merlins" and the two "Ghost" turbines were used together. With the four engines working, at a height of 20,000ft, a speed of 330 m.p.h. was attained, and with the gas turbines alone in operation a speed of 275 m.p.h. was attained at a height of 10,000ft.

Kelvin and Hughes, Ltd.

On Monday, September 1st, it was officially announced that a new company, styled Kelvin and Hughes, Ltd., has been registered, in order to acquire the issued capitals of Kelvin Bottomley and Baird, Ltd., of Glasgow, and Henry Hughes and Co., Ltd., of London. This step merges the interests of two leading British scientific instrument manufacturing firms. The board of the new company will be as follows: chairman, Sir Frederick C. Stewart, with Sir Allan Gordon-Smith as deputy chairman. The joint managing-directors are Mr. Frank Arthur King, A.M.I.E.E., A.F.R.Ae.S., and Mr. George Brian Gibbon Potter, B.Sc., M.I.Mech.E., A.F.R.Ae.S., and the directors are Mr. Ralph Gordon-Smith, Mr. William Thornton Slater, M.Sc., A.F.R.Ae.S., and Mr. Arthur Joseph Hughes, O.B.E., F.R.Ae.S. During the war, we may recall, the distribution and servicing of the marine sections of the two firms were amalgamated in a jointly-owned company known as Marine Instruments, Ltd. This association subsequently led to joint executive management and later to an exchange of shares. The Kelvin firm was originally started by a Glasgow instrument-maker, James White, who was closely associated with developing the ideas of the late Lord Kelvin, who became the first chairman of the company. The present name of Kelvin Bottomley and Baird, Ltd., was adopted in 1913, and the firm now operates factories at Hillington, Glasgow, and Basingstoke, and also has branches in America and in Canada. The firm of Hughes goes back to 1780, when it was founded by William Hughes, a prominent member of the Clockmakers Company. The business was converted into a limited company, Henry Hughes and Son, Ltd., in 1903, and in 1945 it became a public company. Its main works are at Barkingside, Essex. The firm of Kelvin and Hughes, Ltd., will specialise in the production of marine and aircraft instruments with an increasingly wide range of industrial electrical and electro-medical apparatus.

Jubilee of the Discovery of the Electron

It is announced that the Institute of Physics and the Physical Society, in collaboration with the Institution of Electrical Engineers, are arranging a series of lectures and other functions in London on September 25th and 26th next, to mark the jubilee of the discovery of the electron by J. J. Thomson. It is understood that some special lectures and meetings are also being arranged at various centres in the Dominions. Four special lectures have been arranged for the members of the three bodies collaborating in the celebrations. A lecture addressed to the non-scientific public by Sir Clifford Paterson, M.I.E.E., F.R.S., a Past-President of the Institute of Physics and of the Institution of Electrical Engineers, will be given at the Central Hall, Westminster, at 7.30 p.m. on Thursday, September 25th, entitled "The Electron Liberated." The lecture is intended for a lay audience and will be illustrated by experiments and demonstrations. Admission is by ticket only, which may be obtained free of charge from the Institute of Physics, 47, Belgrave Square, S.W.1. Industrial organisations and universities have collaborated with the authorities at the Science Museum, South Kensington, in arranging a special exhibition, which will remain open for about three months. The exhibition will be designed to show the principles underlying the applications of the many devices in which the electron plays an essential part, and to help the visitor to appreciate the important part these developments play in his daily activities. The exhibits will range from Thomson's original apparatus to the most modern developments, such as the electron microscope, and many will be working. A handbook has been specially written by Mr. D. H. Follett, of the Science Museum; the first part is a guide to the exhibition and the second is a general account of the subjects dealt with in the various sections of the exhibition. Copies of the handbook will be on sale at the exhibition, price 1s., and will also be obtainable from the Institute of Physics. The formal opening of the Exhibition will be on the afternoon of September 26th, and it will be open to the public on the next day, September 27th.

Retirement of Mr. Andrew Henderson

The retirement is announced of Mr. Andrew Henderson, M.I.E.E., the Superintendent Electrical Engineer of Canadian Pacific Steamships, Ltd. He will be succeeded by Mr. F. W. Evans. Mr. Henderson, who is sixty-six years of age, was born at Hamilton in Lanarkshire, and served his apprenticeship with the Clydebank Shipbuilding and Engineering Company, Ltd., after which he studied at the Glasgow Royal Technical College. After twelve years with the firm which, it may be recalled, became John Brown and Co., Ltd., Mr. Henderson was appointed electrical manager at Scott's Shipbuilding and Engineering Company, Ltd., at Greenock, a position he occupied for ten years. He was subsequently appointed joint managing-director of J. A. Kinnaird and Co., Ltd., of Glasgow. In 1924 he entered the service of the Canadian Pacific Company and was made responsible for the maintenance of electrical equipment and the supervision of electrical personnel in the company's Atlantic fleet. During his term of office he was responsible for the preparation of specifications for the "Empress" class of liners, the "Duchess" class of passenger ships, and the "Beaver" class of cargo steamers. During the war Mr. Henderson was transferred to the Reconstruction Department of the Company under the direction of Mr. John Johnson, the company's consulting engineer and naval architect, who was responsible for the design, specifications and construction of the new turbo-electric vessels for the Canadian Pacific Railway Company. Since its inception in 1916, Mr. Henderson has been a member of the Institution of Electrical Engineers Committee on Regulations for the Electrical Equipment of Ships, of which a fourth edition is now in preparation. Mr. Henderson also represents the Institution on the Sub-Committee on Marine Electric Cables, Generators and Motors, of the British Standards Institution. We wish him many years of happy retirement.

Engineering and Marine Exhibition at Olympia

No. II—(*Continued from page 192, August 29th*)

WITH this issue we publish another Supplement dealing with the Olympia Exhibition, together with a second Art Supplement. In the following article we describe various other exhibits.

H. E. Lintott, Ltd., and the Crawley Aircraft and Precision Tool Company

On a stand shared by H. E. Lintott, Ltd., of Horsham, and the Crawley Aircraft and Precision Tool Company, Ltd., of Crawley, Sussex, can be seen a representative selection of the products of the two firms. H. E. Lintott, Ltd., is engaged in the production of patterns and special castings in both ferrous and non-ferrous metals, and the display of this firm includes some typical welded repairs which it has carried out.

The tools, jigs and fixtures shown by Crawley Tools include the interesting little drill jig illustrated in Fig. 8. It was

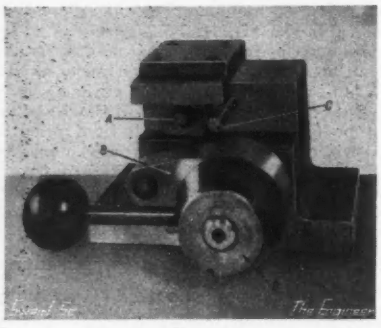


Fig. 8—Drill Jig—Crawley Tools

designed for the purpose of drilling oil holes in gears of varying widths. In each gear an oil hole had to be drilled through the root of the tooth and a phosphor bronze bush set in the gear centre. Normally, a separate jig would have been required for each width of gear but this jig, by the use of interchangeable arbors, is arranged to cover a range of different widths.

Referring to the photograph, the interchangeable arbors A, on which the gears are located, are made with collars of different thicknesses to compensate for the varying widths of gears and to bring the appropriate point below the drill bush in the plate above. Projecting from the face of each collar is a locating peg, which fits between teeth on the pitch line and positions the gears for the entry of the drill. A flat ground on the side of each collar aligns the arbor and locating peg in the jig.

The positive quick-action clamping unit of the jig is of interest. It consists of a spindle passing through the body of the jig, the forward, projecting part of which carries the clamping assembly. The projecting length of the spindle can be set, according to the width of the gears to be held, by the arrangement of loose collars of suitable thickness, seating in a counterbored hole, behind the spindle holding nut. The clamp arm B is free to rotate and slide along the projecting spindle. The rotary movement of the arm is limited by a peg C, which sets the arm in the gear clamping position. A clamping nut D is screwed on a Whitworth thread on the end of the spindle. A peg projecting from the inner face of the nut fits into an annular groove cut into the face of the clamp arm. A long helical spring coiled in the groove is pinned to prevent its free movement round the groove.

When a gear has been placed in position on the arbor, clockwise movement of the clamping nut handle brings the arm into the clamping position with a forward movement equal only to a fraction of the pitch. Continued rotation of the nut carries the arm forward on to the end of the gear to lock it securely in position. The coiled spring is compressed through the angular movement and when the handle is tripped to release the gear the loaded spring quickly carries the clamping nut and plate clear of the gear.

F. J. Edwards, Ltd.

A recent addition to the range of sheet metal working machines made by F. J. Edwards, Ltd., 359–361, Euston Road, London, N.W.1, is the high-speed nibbling machine illustrated in Fig. 9. It is designed for cutting all types of regular or irregular shapes, and has a capacity of up to $\frac{5}{16}$in mild steel. It can cut circles of from 7in to 30in diameter. It is driven by a 2 h.p.

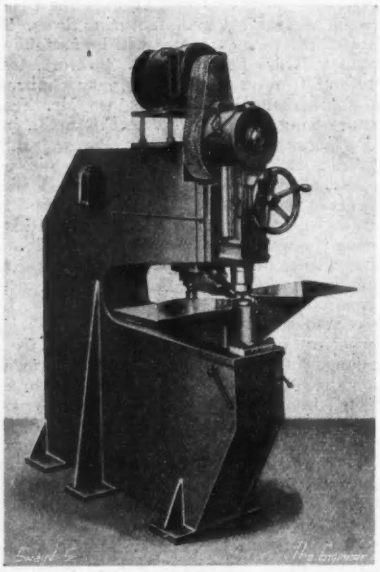


Fig. 9—Plate Nibbling Machine—Edwards

motor at 1425 r.p.m., which transmits, through a vee belt and two-step pulleys, 720 or 1000 strokes per minute to the ram.

The piston ram, which is of steel, is balanced and moves in long bronze bearings which can be adjusted to take up wear. A conveniently placed handwheel on the head enables the ram to be raised and lowered when it is required to start cuts on the inside edge of a pre-punched blank. The eccentric shaft is mounted in Timken roller bearings and the pitman is mounted on matched bearings.

A collet chuck in which the punch is held allows it to be turned to cut in any required direction. At the rear of the ram a stripper and circle-cutting device is mounted on a slide in the throat of the machine.

This firm is also exhibiting a comprehensive range of sheet metal working machinery, including treadle and power-operated guillotines, folding machines, swaging, wiring and jennying machines, &c. As an example of the power presses it makes, the firm is showing an eccentric punching press which has an adjustable stroke and a rise and fall table. The largest machine in this range is of 70-ton capacity and can be supplied geared or ungeared.

Auto-Klean Strainers, Ltd.

The new "Flushflo" strainer exhibited by Auto-Klean Strainers, Ltd., Staines Road, Hounslow, Middlesex, is a development of the firm's well-known "Lolos" self-cleaning strainer. It has been designed to combine fine filtration with ease in cleaning.

The arrangement of the cartridge and the means of cleaning the strainer can be

Fig. 10—"Flushflo" Cartridge with Scraper—Auto-Klean

clearly seen from the photograph reproduced in Fig. 10. The straining medium comprises a cylindrical former having longitudinal ribs, with access from the outside to the inside. The outside of this cylinder is screw-cut and wound with wire. By varying the thread pitch and wire diameter any desired mesh from 0·0005in upwards can be produced. In operation the fluid to be filtered passes from the outside to the inside of the cartridge, depositing solid particles in suspension on the outside of the mesh. When it is required to clean the cartridge it is rotated by means of a handle outside the body of the strainer against the fixed scraper, which can be seen in the illustration. This scraper removes and deposits into the body sump the larger solids collected on the wire mesh.

The scraper is hollow and has a longitudinal slot in its face, which is spring loaded against the cartridge. The slot opens out into a hole bored through the length of the scraper, and this hole communicates with an external controlling cock. When this cock is opened the pressure inside the cartridge creates a reverse flow through the mesh, through the slot in the scraper and out through the cock. During its passage between the wires the reversed flow of liquid carries with it all the small particles not removed by the scraper. In the case of water it is usual to lead this reverse flow of liquid to waste, but when oil is being treated it is

passed through a sediment collector, which separates the suspended particles.

It is stated by the firm that a choked cartridge giving a pressure loss of 50 lb per square inch can be cleared and the pressure loss returned to its normal 2 lb to 4 lb per square inch in about ten seconds.

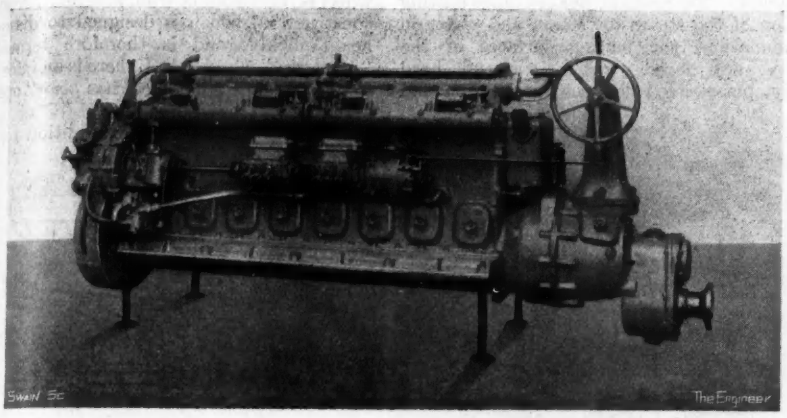


FIG. 11—EIGHT-CYLINDER 160 B.H.P. ENGINE AND REVERSE REDUCTION GEAR—GLENIFFER

GLENIFFER ENGINES, LTD.

Gleniffer Engines, Ltd., of Glasgow, display two examples of the firm's well-known straight eight Gleniffer oil engines, each having a designed output of 160 b.h.p. when running at 900 r.p.m. As will be seen from our engravings, Figs. 11 and 12, the engines are arranged for driving propellers through reduction gear, which has a ratio of 2:1. This type of prime mover will be familiar to many who served in the H.D.M.L. 72ft ships of the Navy during the war. In this case, however, as the engines chosen for exhibition will be fitted in a vessel larger and heavier than the 72 footers, reduction gears have been added.

The policy of Gleniffer Engines, Ltd., has been to continue in general its pre-war building programme, incorporating in the post-war designs improvements and refinements which were shown to be of proved value in service. We may mention the new control pedestal for the reverse gears and the thermostatically controlled engine cooling system.

In the pre-war years the range of Gleniffer engines extended from 24 b.h.p. to 320 b.h.p., but the construction of the two largest units in the series has been temporarily suspended, and the engines shown on the stand are now the largest for current production manufactured by the firm.

Export orders figure prominently in the manufacturing programme, and this type of propelling machinery has been chosen for special experimental 65ft herring boats for the Herring Industry Board, a new fishing boat of unusual interest, sponsored by a well-known naval architect and the engine builders. It will be engined with the same type of machinery as seen on the stand, and it is expected that this ship will be in service in 1948.

A large number of overseas orders, we learn, are also in hand for small cargo-carrying craft, tugs and passenger boats, calling for total powers between 100 b.h.p. and 300 b.h.p. The firm's D.C. series of engines with a design output per cylinder of 20 b.h.p. are in the greatest demand, and in most instances reduction gears are fitted in the interests of propeller efficiency. They are designed to give speeds of either 300 r.p.m. or 450 r.p.m. at the propeller shaft.

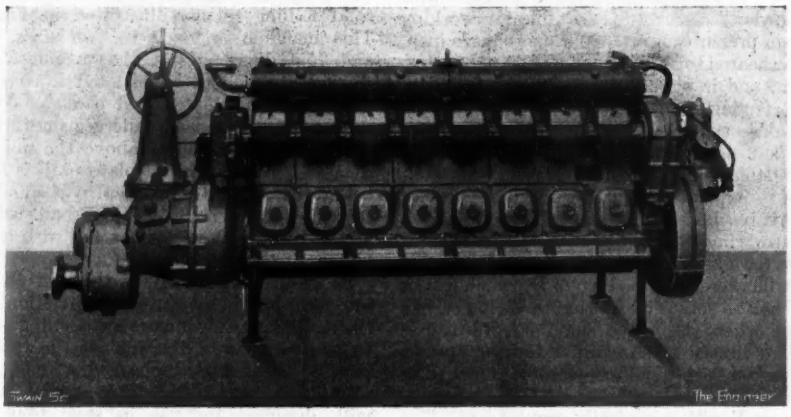


FIG. 12—EIGHT-CYLINDER 160 B.H.P. ENGINE AND REVERSE REDUCTION GEAR—GLENIFFER

MONO PUMPS, LTD.

The pumps exhibited on the stand of Mono Pumps, Ltd., 67, Clerkenwell Road, London, E.C.1, are those which are specially designed for marine purposes, including bilge, oil transfer, fresh water, cooling water, brine, sanitary and general service.

The principle of the pump is now well known. It briefly consists of a hardened corrosion-resisting metal rotor of helical spiral form which rotates in a stator of natural or synthetic rubber. The hardened metal rotor and resilient rubber stator form an excellent combination of corrosion and abrasion-resisting materials, their lubrication being effected by the liquid being pumped. The geometry of the design is such that each cross-section of the rotor traverses the stator in a straight-line path, on a plane perpendicular to the stator, the stator being shaped internally to accommodate this motion. In operation the rotor maintains a constant positive seal across the stator and this seal travels continuously along the stator, thereby discharging the liquid in a uniform and steady stream with positive displacement. With the absence of valves and cylinder clearances, the pump is an effective air exhauster, provided only that sufficient liquid is present to maintain a lubricating film between the stator and rotor. It works with equal facility with any proportion of air and water, and can prime itself, even with high suction lifts, when operating intermittently with an uncovered suction or in overcoming adverse suction conditions.

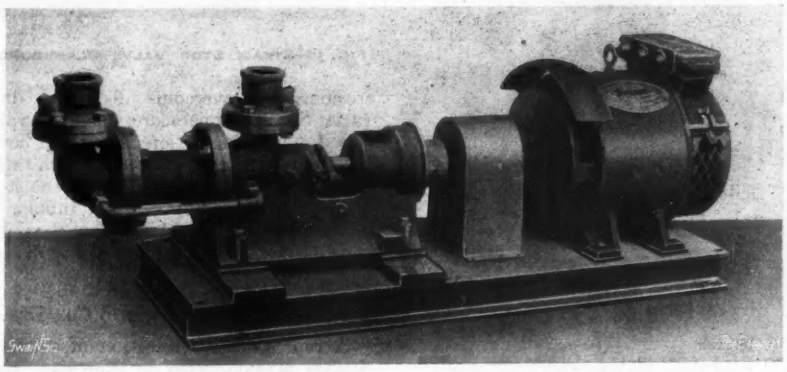


FIG. 13—FRESH WATER PUMP—MONO PUMPS

The pump shown in the accompanying illustration, Fig. 13, is the firm's "D 6" type for fresh water service; it is driven by a 4 h.p. variable-speed motor.

J. BLAKEBOROUGH AND SONS, LTD.

An electrically operated sluice valve, complete with push-button controls, is arranged for demonstration amongst examples of its many other products on the stand of J. Blakeborough and Sons, Ltd., of Brighouse, Yorks. This valve, which is illustrated in Fig. 14, is based upon the firm's well-known sluice valve design, but is modified to suit the requirements of motor operation. The valve is made with an inside screw, an outside screw-raising spindle or an outside screw tubular spindle, the one

exhibited being of inside screw construction with a motor-operated single-worm gear.

In order to eliminate vibration and reduce frictional resistance and wear, gunmetal shoes on the gate are machined to a close working clearance and machined bronze guide channels are let into the body.

A feature of the gear unit is a torque limiting clutch, which gives accurate control of the force applied when closing the valve and also transmits the extra torque required for the opening operation. The action is positive and sensitive, enabling all stages of operation to be carried out without necessity for direct observation of the valve. The clutch, together with the reduction gear, is housed in a cast-iron case; the gears run in

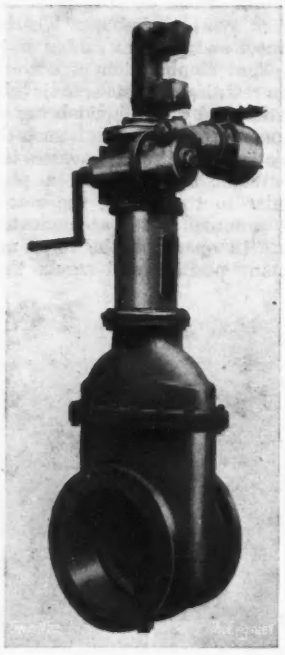


FIG. 14—ELECTRICALLY OPERATED SLUICE VALVE—BLAKEBOROUGH

oil and the end and radial loads in the worm shafts are taken by ball bearings. Ball thrust bearings are also provided to take the axial load on the main valve spindle. Provision is made for emergency manual operation, an interlocking switch ensuring that the motor cannot be started up when the operating handle is in position.

Self-resetting limit switches cut out the motor in the open and closed position of the gate. In practice the "closed" limit switch is arranged to operate just before the gate reaches its seat, indicated at the remote control point by a signal light switching off. A special seating push button is then depressed for a few moments; during this period the clutch slips and teeth engage and disengage to deliver a series of controlled hammer blows, which bed the gate down correctly to its seat. When required, a small relay is incorporated in the motor starter for carrying out the seating process automatically.

The push-button unit exhibited is an example of a wall-mounting type for control of a single valve. Coloured signal lights for "Valve Open" and "Valve Closed" are provided, and also a dial indicator electrically operated by a corresponding transmitter of the variable resistance type mounted on the valve, which shows accurately the degree of opening.

The Boyd patent steam stop valve to be seen on this stand, and which is illustrated in the engraving Fig. 15, has been specially developed for severe condition drain and stop valve duty. It is of the seat and stopper type and is available in cast steel and forged steel, of globe, angle and inclined spindle patterns. To provide against the cutting action of the steam (or steam and water in combination) the mating surfaces of the valve are faced with a special hard alloy, possessing resistance to abrasion and

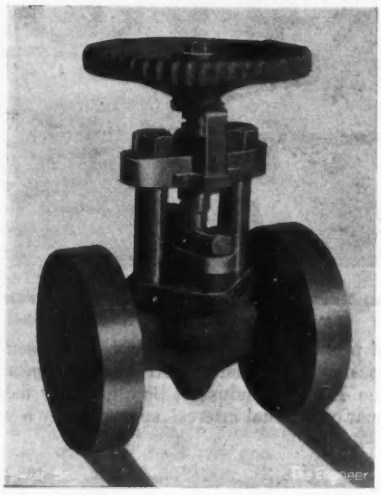


FIG. 15—STEAM STOP VALVE—BLAKEBOROUGH

erosion. To overcome distortion due to variations in temperature when the valve is closed a wedging action is effected between the faces. The ring stopper enters a tapering seat and line contact is made on the stopper periphery. The stopper is of tubular form at the seating end, and sufficient flexibility is thus allowed to accommodate any distortion that may occur.

NEWMAN, HENDER AND CO., LTD.

A representative selection of valves and fittings manufactured by Newman, Hender and Co., Ltd., of Woodchester, Stroud, Glos, is displayed on the firm's stand. Gunmetal-bolted cover stop valves of robust construction exhibited are of particular interest to marine engineers.

Sectionally illustrated in Fig. 16 is the Newman-Bowler steam valve, which has many points of interest. The particular valve illustrated is described by the firm as the No. 825 gunmetal union bonnet external screw, "controlled ball," valve, with "Bowler" seat. It is suitable for working steam pressures up to 300 lb per square inch, superheated to a total temperature of 600 deg. Fah., and is made in a wide range of sizes.

Referring to the drawing, a renewable stainless steel ball A seats at an angle of 60 deg. on a stainless steel renewable and reversible self-aligning seat ring B, which is free to expand or contract independently of the valve body. The seat is retained by a bronze ring C having conveniently placed slots for a key. At the lower end of the valve spindle there is formed a cup D, which causes the ball to rotate by friction in various directions when the valve spindle is turned in either direction. A gland E for the spindle is packed with moulded asbestos rings. The assembly is held together by a strong union bonnet F with a conically ground seat. The two faces G form a shut-off, permitting the gland to be repacked under pressure when the valve is fully opened.

The spindle itself is of hard-drawn phosphor-bronze and has cut on it Acme square threads H having ample engagement with the bonnet thread when the valve is closed. An improved method of adjusting the packing gland by turning the assembly J mounted on the bonnet is claimed. Finally, the handwheel K, of malleable iron, is of an interesting construction, which is designed to dissipate heat quickly, and is therefore termed a "Coolgrip" wheel. At L there is an information disc, whilst the wheel has also "open" and "shut" indicators.

Exhibits on the stand in addition to the

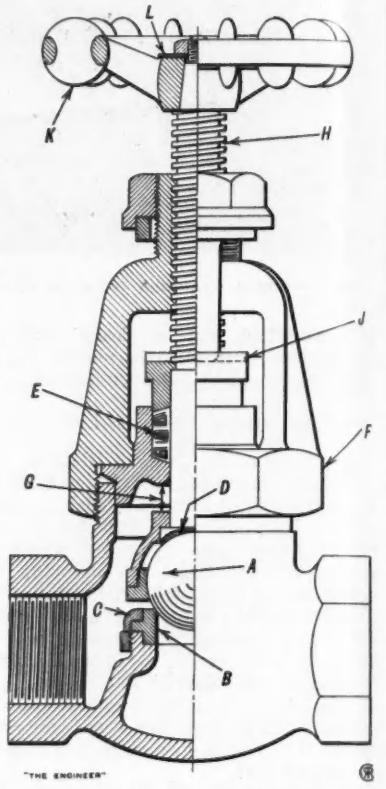


FIG. 16—HALF SECTION THROUGH NEWMAN-BOWLER STOP VALVE—NEWMAN HENDER

valve described above include the Newman-Carter steam trap, Newman-Milliken glandless lubricated plug valves and a range of forged steel valves and fittings for high pressures and temperatures.

J. W. JACKMAN AND CO., LTD.

The range of foundry plant exhibited by J. W. Jackman and Co., Ltd., of Blackfriars Road, Manchester, includes the new sand milling mixer, illustrated in Fig. 17. This machine is made in two sizes, 60in and 75in diameter, and has a conical roll carried on completely enclosed taper roller bearings. The dish-shaped pan has sloping sides and is rotated by undergearing through vee belts from a motor above the mill. A renewable wear-resisting plate path is fitted below the pan. The vertical pan spindle is carried in an enclosed radial ball bearing at the top and a radial bearing with thrust washer at the base.

Scrapers on the side of the pan give an intensive mixing action in conjunction with the milling, as they impart a cascading action to the sand down the side of the rotating pan. The sand is discharged at one point over the pan edge. The special heavy mill, designed for use in steel foundries, is 75in diameter and has a heavier roll, the pan being mounted on idler rollers.

A new jolt squeeze stripper, shown in Fig. 18, made by the firm, takes boxes up to 18in by 28in and has a pattern draw

of up to 6in. It has a heavy beam squeeze head with a supporting bracket at the rear to resist bending stress, and a ball bearing mounted head adjustable for right or left swing. A replaceable contact head is adjustable to compensate for wear and maintenance of parallel alignment between the table and the head.

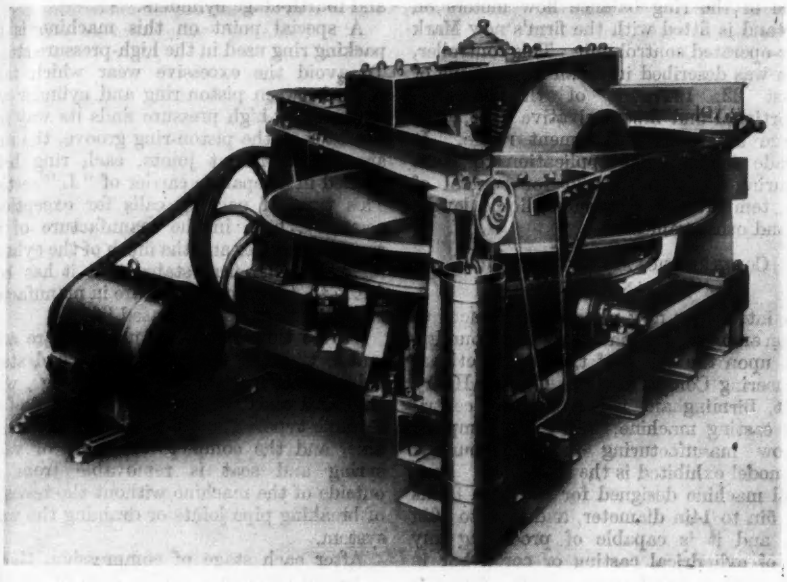


FIG. 17—SAND MILLING MIXER—JACKMAN

Pattern mounting slots are provided in the jolt-table and two combination guide and limit pins maintain the accurate alignment of the table and serve as safety stops. The machine has oil-type draw control with automatic acceleration from slow to fast draw and automatic cushioning at the end of the draw stroke. The draw stroke may be conveniently set for any length of travel up to the maximum and for speed of slow draw. The pattern vibrator control is adjustable for length of vibrating interval and is automatically synchronised with the draw mechanism. Lifting pins, adjustable for wide range of flask shapes and sizes, fitted on the machine are carried on the cast draw frame of squaring shaft construction. This design makes it mechanically necessary for all parts of the draw mechanism to function with uniform accuracy and the movements of the four lifting pins are synchronised.

The jolt and squeeze movements are controlled by a rugged disc valve and draw is controlled by a combination hand and knee valve, so that the operator can lower the draw frame by knee action while both hands are engaged in lifting off the mould.

On this machine the draw, jolt and squeeze cylinders are cast separately and bolted in the machine in order that maintenance or replacement can be quickly and easily effected. The cylinders and their hardened pistons are finish ground to final limits and the ratio of length to diameter of the shielded and protected jolt and squeeze pistons provides large bearing areas.

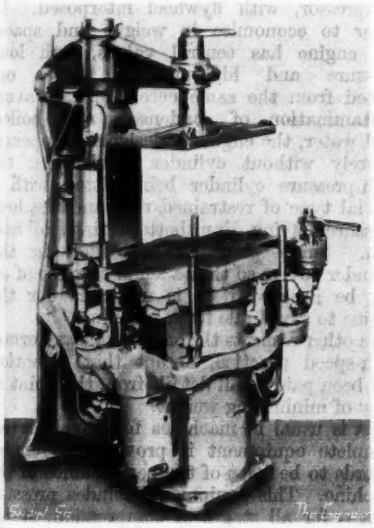


FIG. 18—JOLT SQUEEZE STRIPPER—JACKMAN

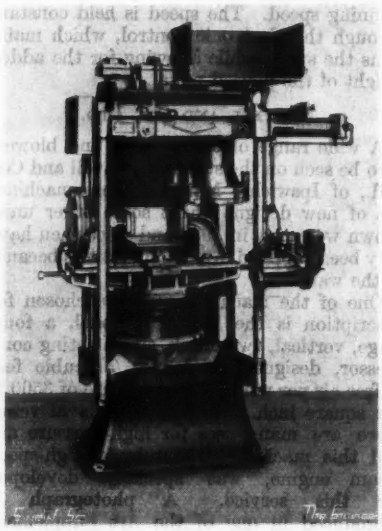


FIG. 19—PNEUMATIC CORE BLOWER—JACKMAN

An Osborn pneumatic core blower on the stand is designed to produce cores up to 15 lb in weight. This machine, which is shown in Fig. 19, is fitted with an automatically operated air clamp, which rigidly holds the core box during blowing.

In operation, sand is fed into the overhead storage hopper and falls directly into the sand reservoir. When the clamping of the core box has been effected the sand reservoir moves over it and blowing immediately takes place. When the hand control lever is reversed the reservoir moves back into its original position under the hopper, to be recharged, and the core box is released for the finished core to be removed. It is stated that the cycle of operations takes about ten seconds.

GEORGE KENT, LTD.

Included in the wide range of water, air, gas, and other types of meters upon the stand of George Kent, Ltd., of Luton, is to be seen the firm's new design of ring balance meter for the measurement and recording of air or gas flows at pressures up to 10 lb per square inch.

With this instrument a differential pressure producing device in the flow line is connected to the limbs of a liquid sealed U tube. This tube, as can be seen in the engraving, Fig. 20, is in the form of an annular chamber or hollow ring. A partition in the top of the ring isolates the high and low pressures from each other and a baffle plate is set in the lower section to prevent surge of the liquid seal in the event of sudden changes in the flow line. The material used in the construction of the ring is a transparent plastic designed to withstand the effects of corrosive gases.

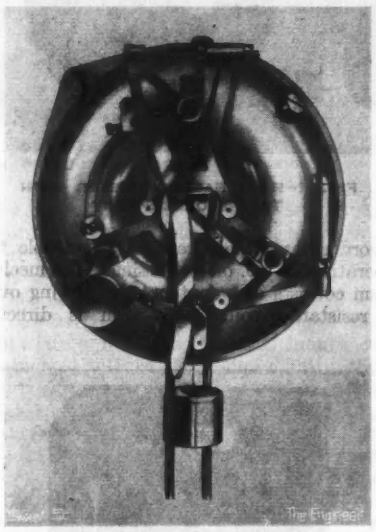


FIG. 20—RING MECHANISM OF RECORDER—KENT

The ring rotates about its centre and is balanced on a knife-edge. The torque derived from the difference of pressure acting on the partition at the top of the ring is balanced by a control weight suspended by a stainless steel tape, which rides on a machine-generated cam. This cam is designed to extract the square root relationship so that flow is expressed directly in uniform increments on the chart or scale of the instrument.

The maximum operating head of the meter, which may be selected at will from ½in to 5in water gauge, is determined by using an appropriate control weight. The meter can stand 8in differential pressure before gas passes the liquid seal, or the equivalent of 50 per cent overload on a 4in head and 300 per cent on a ½in head. If the differential is further increased, the gas bubbles harmlessly from upstream to downstream and the liquid in the ring returns to normal on equalising.

The recording pen is attached to the balanced ring and traces the record on a continuous roll chart, measuring 5in from zero to full flow line, driven at a standard speed of 1in per hour. If required, change wheels can be fitted to give speeds of 2in or 3in per hour.

The ring balance mechanism is built in a number of standard forms by the firm, and in Fig. 21 it can be seen with a tele-

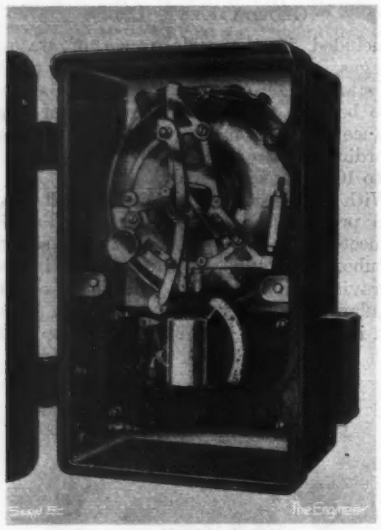


FIG. 21—RING BALANCE METER WITH TELERECORDER—KENT

recorder for remote recording, suitable for operation on a.c. or d.c. mains. The mechanism consists of a contact arm moving over a resistance coil. This arm is directly

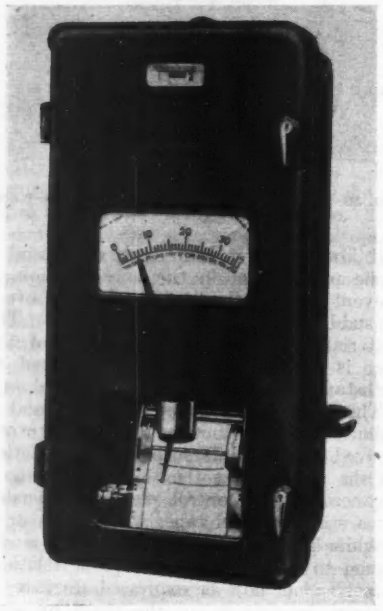


FIG. 22—FLOW RECORDER WITH INDICATOR AND COUNTER—KENT

operated by the ring balance movement. The resistance coil is fed with an electrical supply through a separate mains unit, which maintains a constant current value and the instrument is unaffected by voltage variation. The voltage between the moving contact and one end of the coil is impressed on the receiver, which is of the voltmeter pattern. The mechanism is mounted on a pressed steel base-plate and the combination of cam, link mechanism and resistance former shape is designed to give a true relation between flow and voltage, thereby giving almost equally spaced flow on the distant recorder chart. Flow is indicated on a sector type rate of flow scale. In Fig. 22 we show a flow recorder fitted with an indicator and counter mechanism.

One of the ring balance flow meters on the stand is fitted with the firm's new Mark 20 air-operated control unit. This controller, which was described in detail in our issue of August 22, 1947, is of the integral, proportional and first derivative type, with a large sensitivity adjustment range. It is made for univeral application to Kent measuring instruments and for control of flows, temperatures, pressures, liquid levels, pH, and other values.

CONSTRUCTIONAL ENGINEERING COMPANY, LTD.

An interesting new piece of equipment to be seen amongst the familiar range of foundry plant upon the stand of the Constructional Engineering Company, Ltd., Charles Henry Street, Birmingham, is an American centrifugal casting machine, which the company is now manufacturing in this country. The model exhibited is the "M 12–12" horizontal machine designed for use with flasks from 5in to 14in diameter, and 20in to 30in long, and it is capable of producing any type of cylindrical casting or cored bar in either steel or non-ferrous metals. Castings can be produced in either a permanent metal mould or a sand moulded flask. The flasks are held down on a pair of driving pulleys and a pair of supporting rollers by an overhead air-operated arm. They are rotated at an infinitely variable speed, ranging from 0 r.p.m. to 2500 r.p.m., full electronic control being incorporated in the drive.

In operation the mould in the machine is brought up to the proper speed, and a weighed amount of metal is poured. The electric equipment is provided with torque control to prevent excessive overload during the acceleration of the heavy moulds up to spinning speed. The speed is held constant through the electronic control, which maintains the speed while allowing for the added weight of the poured metal.

REAVELL AND CO., LTD.

A wide range of compressors and blowers is to be seen on the stand of Reavell and Co., Ltd., of Ipswich. Many of these machines are of new design, whilst some other units shown were new in 1939 and since then have only been supplied in small quantities because of the war.

One of the machines we have chosen for description is the "TC 6" model, a four-stage, vertical, two-crank, single-acting compressor, designed to deliver 70 cubic feet of free air per minute at a pressure of 3500 lb per square inch. In a modern naval vessel there are many uses for high-pressure air, and this machine, driven by a high-speed steam engine, was specially developed for this service. A photograph is reproduced in one of the Art Supplement pages illustrating the complete set as shown at Olympia and as supplied to the Admiralty. Essential requirements were that the set should be as compact and as light as possible, consonant with ability to resist shock due to explosion of mines or due to shell fire.

As already mentioned, the compressor is a four-stage machine, the third and fourth-stage pistons being mounted in tandem over the second and first-stage pistons, respectively. The main cylinder block is of gun-metal with inserted liners for the first and second-stage cylinders. The first-stage cylinder cover is also of gun-metal, and the valves are so spaced as to leave room between for the fourth-stage cylinder barrel, which is fitted with a cylinder liner of close-grained hard cast iron. The second-stage cylinder cover is similarly designed to house the third-stage barrel. Small removable cylinder covers of brass are fitted to both the third and fourth-stage cylinders.

A special point on this machine is the packing ring used in the high-pressure stages. To avoid the excessive wear which takes place between piston-ring and cylinder wall when air at high pressure finds its way into the back of the piston-ring groove, the rings are made without joints, each ring being carried in a separate carrier of "L" section. This type of packing calls for exceptional accuracy, both in the manufacture of the rings themselves and the finish of the cylinder liner, but the firm states that it has been found that this increased care in manufacture is amply repaid by increased life.

Valves throughout the machine are automatic, those in the first and second stages being made in the form of flat rings, while the third and fourth-stage valves are of the thimble type. All valve seatings are renewable, and the complete assembly of valve, spring and seat is removable from the outside of the machine without the necessity of breaking pipe joints or draining the water system.

After each stage of compression, the air is passed through a cooler, each of which is withdrawable for cleaning. Moisture separators are installed at suitable places in the compression system.

The running gear is of the normal high-speed engine type with adjustable white-metal-lined bearings, and with fully forced lubrication. For the cylinders a mechanical lubricator is provided which is driven by chain and worm gearing from the crankshaft. The whole of this gearing is enclosed and flooded with oil.

Power for driving the compressor is supplied by a two-crank, compound, double-acting, steam engine, directly coupled to the compressor, with flywheel interposed. In order to economise in weight and space, the engine has central valves, with low-pressure and high-pressure valves operated from the same eccentric. To avoid contamination of condensers and boiler-feed water, the engine is designed to operate entirely without cylinder lubrication, the high-pressure cylinder being fitted with a special type of restrained ring and the low-pressure having Ramsbottom rings of cast iron. Small plugs are provided in the cylinder covers so that a small amount of oil can be inserted if it is necessary for the engine to stand idle for a long time.

In other respects the engine follows normal high-speed practice, except that attention has been paid to all details from the point of view of minimising weight.

As is usual in machines for naval service complete equipment is provided to enable records to be kept of the performance of the machine. This equipment includes pressure gauges for all stages of compression, steam pressures and forced lubrication pressures, also thermometer pockets for the recording of interstage and oil temperatures, and a tachometer to permit the speed to be checked.

In Fig. 23 is illustrated another new design to meet the requirements, largely for marine purposes, for charging starting air bottles for diesel engines. It is designated the "M.C.S.A.9" type, and running at 480 r.p.m. the designed delivery is 143 cubic feet of free air compressed to 600 lb per square inch. The machine illustrated is motor-driven by vee-belt, an accepted method of

drive for marine purposes on the Continent, whereas British shipbuilders usually prefer directly coupled plants. In addition to the purpose for which it was originally designed, it has also found useful application for such purposes as air-operated injection moulding.

The "M.C.S.A.9" machine is a two-stage, single-acting, two-crank compressor. A tubular intercooler is provided between the stages, also an aftercooler contained in the intercooler casing, which is integral with the crankcase. The compressor is completely water-jacketed, with removable cylinder head containing the suction and delivery valves. Lubrication is automatic by oil throwers on the connecting-rod b'g-ends.

An interesting high-pressure machine is the "S.A.T.5," illustrated in Fig. 25 herewith. This compressor is of a type which has been developed for such industrial uses as charging air-loaded hydraulic accumulators, and it has also been used successfully for the compression of various gases in the chemical industry. It is of the three-stage, two-crank, single-acting type, having the first and second stages arranged in tandem on one crank, whilst the other crank is given over to the high-pressure stage.

By thus separating the stages of compression, it is possible to run the high-pressure line with the fine clearances necessary to enable a working pressure of 4500 lb per square inch to be achieved, and also to provide a guide of large diameter at the lower end of the high-pressure piston to the straight-tube type, ingeniously arranged concentrically with one another, so that only a single cover has to be lifted to enable the tubes to be inspected. A coiled high-pressure cooler is fitted, made from solid drawn copper or other material, according to the working pressure.

Two types of air starter motor are shown on the firm's stand, one being designed for engagement by hand lever and the other of self-engaging Bendix type.

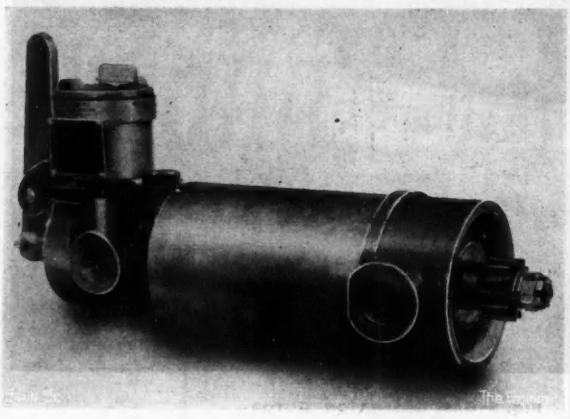


FIG. 24—AIR STARTING MOTOR—REAVELL

The 6in lever-controlled type illustrated in Fig. 24 is a rotary machine operating on compressed air at pressures between 80lb and 300 lb per square inch, and is suitable for starting internal combustion engines of 50 to 300 b.h.p. The machine shown is the larger of the two sizes manufactured. The maximum starting torque available is 74 lb-ft with air supply at 300 lb per square inch.

This starter was originally designed to be interchangeable with the 6in electric starter on mines locomotives and for other applications where flameproof machinery is required. The low pressure required makes it particularly suitable for mines work as the normal air supply found in the main roads of mines, *i.e.*, 80 lb per square inch, can be used. Even where flameproof construction is not necessary this machine provides a convenient method of starting, especially in cases where a compressed air supply is already available, as it eliminates the batteries and dynamos associated with electrical starting.

The starter is of very compact design. It consists of a cylindrical outer sleeve by which the starter is cradle-mounted on the side of the engine (in the same way as an electric starter) and inside this sleeve is a rotary air motor with an overhung driving pinion. The complete motor is a sliding fit in the outer sleeve and when the operating lever is pulled to the left, the air motor is moved to the right to engage the pinion with the gear ring on the engine fly-wheel. The same movement opens the valve and admits pressure air to the inlet port in the casing, where it acts upon the blades causing the shaft and pinion to rotate.

The valve is not fully open until the end of its travel, but is so arranged that immediately it leaves its seat enough air is admitted to turn the motor slightly, thus facilitating engagement with the starter ring.

When the operating lever is released the motor is automatically moved to the left, withdrawing the pinion from engagement, and the valve closes immediately, shutting off the air supply and stopping the motor.

Lubrication is automatic and operated by the air supply, so that when the motor is running a steady supply of oil is fed in through the inlet port. When the air supply is shut off and the motor comes to rest, the supply of oil ceases.

(To be continued)

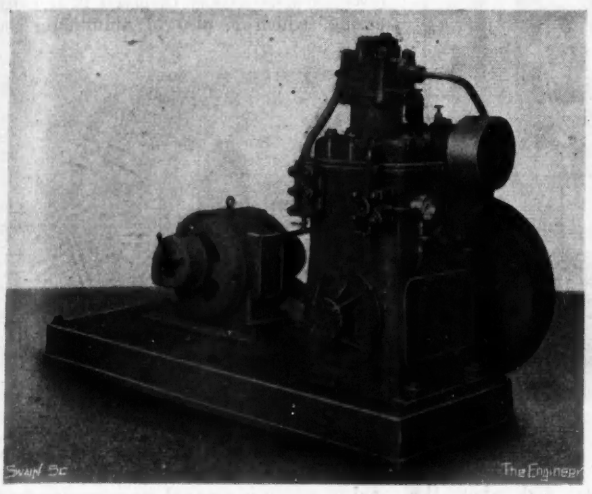


FIG. 23—"M.C.S.A.9" MARINE COMPRESSOR—REAVELL

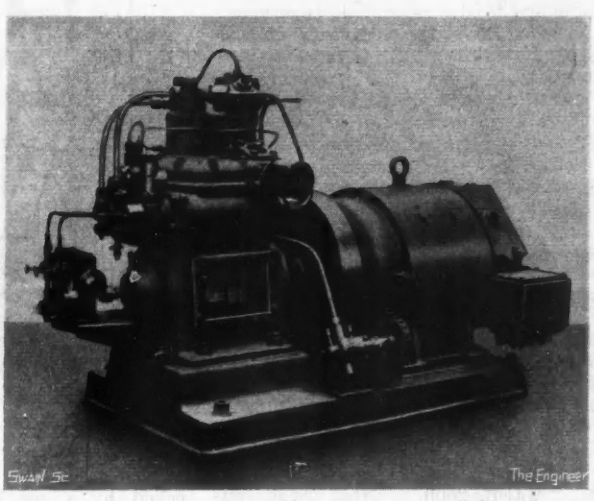


FIG. 25—"S.A.T.5" HIGH PRESSURE COMPRESSOR—REAVELL

POPLAR POWER STATION.—Demolition work has been started at Brunswick Wharf, Blackwall, in London's Dockland, as a preliminary to a new electricity generating station which the Poplar Borough Council proposes to build on the site of the East India Export Dock. According to the *P.L.A. Monthly*, the site of the new station, which has been purchased by the Poplar Borough Council from the Port of London Authority, will have an area of 17¼ acres, of which 8 acres include the dock proper. The station itself is to be built in the actual dock, the remainder being utilised as a coal stock yard. Brunswick Wharf will disappear and colliers up to 8000 tons will be accommodated on the river frontage of the new station, and it is possible that the station will be served by its own fleet. It is also recalled that Blackwall's association with Thames shipping is rooted in very ancient times. By the seventeenth century it was a major shipbuilding and repairing base for both the Royal Navy and the East India Company. A large part of the area acquired for the new power station was at one time part of the Blackwall Yard, which, now occupying a much-restricted site immediately upstream of the East India Export Dock, claims to be the oldest active shipyard in the world. Its greatest days were under Wigram and Green in the heyday of "sail"; Blackwall frigates and the later clippers took the term "Blackwall Fashion" all over southern and eastern seas. Blackwall Yard no longer builds ships, but its ship-repair facilities are one of the features of the modern port.

Gas Turbine Propelled "M.G.B. 2009"

No. I

LAST Friday, at Portsmouth, we were privileged to attend the trials of the first vessel ever to be propelled at sea by a gas turbine. The craft concerned, which is illustrated in Fig. 1, is an experimental naval craft, "M.G.B. 2009." This boat was originally equipped with three 1250 b.h.p. Packard engines, driving each its own propeller through a reduction gear. In place of the central engine of these three, there has been installed a Metropolitan-Vickers gas turbine unit developing 2500 s.h.p. and driving the central propeller. For cruising the two reciprocating engines alone are used. Maximum ahead power is obtained very rapidly by bringing the gas turbine also into operation. The characteristics of the simple cycle gas turbine which has been installed include low overall specific weight and size, combined with the ability to develop full power from cold very rapidly. This combination of qualities makes it particularly suitable for the propulsion of light vessels, which often require high speeds for limited periods and at short notice.

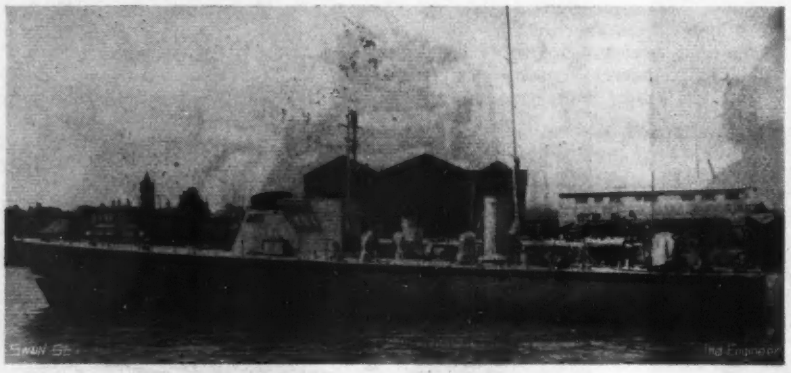


FIG. 1—"M.G.B. 2009"

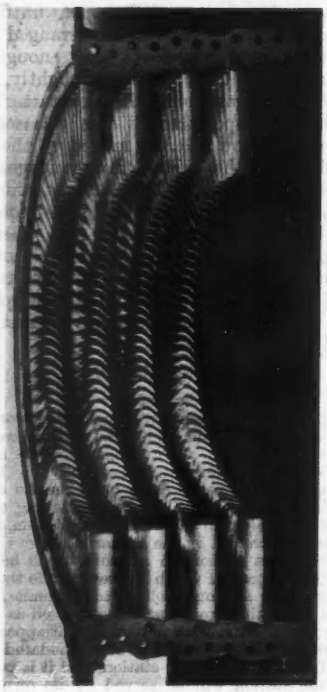


FIG. 2—FIXED BLADES OF POWER TURBINE

This is the first naval vessel ever to be propelled by a gas turbine, and when the Admiralty entrusted the equipment to the Metropolitan-Vickers Electrical Company, Ltd., it was decided that a jet engine that had already been developed by the company should be employed for the gas generator portion of the plant. New development, as far as the gas turbine was concerned, was thus in the main confined to the power turbine and its gears and to certain modifications to the control system. It was fully appreciated at the outset that this jet engine or gas generator possessed performance characteristics that were not ideal for use with power turbines for duty of this character, chiefly in respect of its somewhat low compression ratio, and it was realised that overall efficiency would be affected on this account. It was felt, however, that only by such means could experience be obtained in the actual operation and control of such a craft within a reasonably short time. Moreover, with a gas turbine that is essentially a peak-load plant fuel consumption is of secondary importance.

The Metropolitan-Vickers gas turbine plant comprises a gas generator consisting of a compressor, a combustion chamber and a turbine driving the compressor, axially in line with a power turbine mechanically independent of the compressor turbine and coupled by a reduction gear to the propeller shaft. The complete unit is shown diagrammatically in longitudinal section opposite.

GAS GENERATOR

The compressor is a nine-stage axial-flow machine with aerofoil section blades of aluminium alloy. The moving blades are mounted in axial serrated slots in a forged aluminium alloy drum, and the fixed blades in dovetail slots axially disposed in the stator casing, which is also of aluminium alloy.

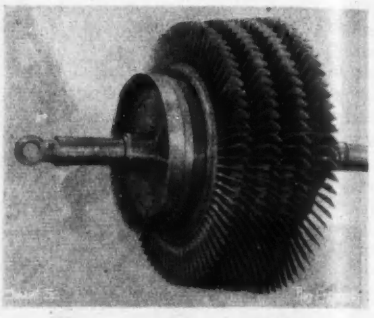


FIG. 4—POWER TURBINE ROTOR

The rotor, which is shown in Fig. 3, is provided with a conical extension piece, to the end of which is secured an extension for the mounting of the turbine disc. This combined rotor is carried in two ball bearings with the turbine disc overhung. The forward or compressor end bearing acts as a thrust bearing; the turbine end bearing is carried in a splined housing, which has freedom of axial movement against spring compression.

These bearings are lubricated by an oil mist, the oil being supplied from two feeds of a small eight-feed positive-displacement pump. The oil so fed is entrained in air taken from the fifth stage of compression and is directed on to the bearing. The oil is not recirculated, but the quantity used is very small, being of the order of 4 pints per hour, including oil for the power turbine bearings and auxiliaries. The bearings are cooled also by means of air taken from this stage of the compressor and led through the interior of the rotor to ventilating air passages formed in both rotating and stationary bearing housings. On the casing of the compressor are mounted various auxiliaries, including fuel pump, governor, tachometer generator, electric starting motor and lubricating oil pump, together with fuel control and relief valves. A mechanical drive for the auxiliaries

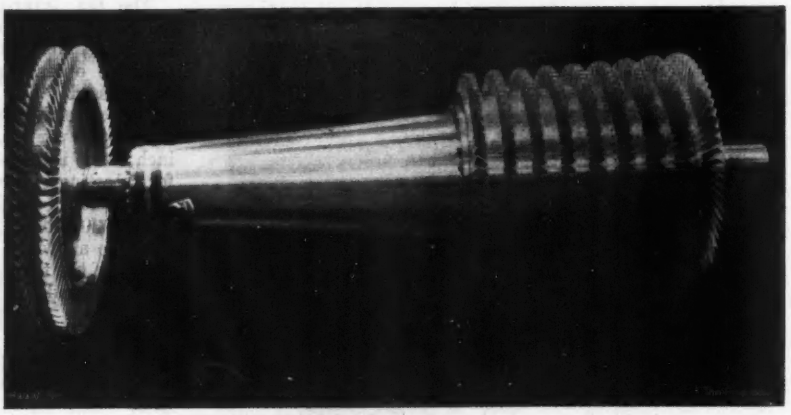
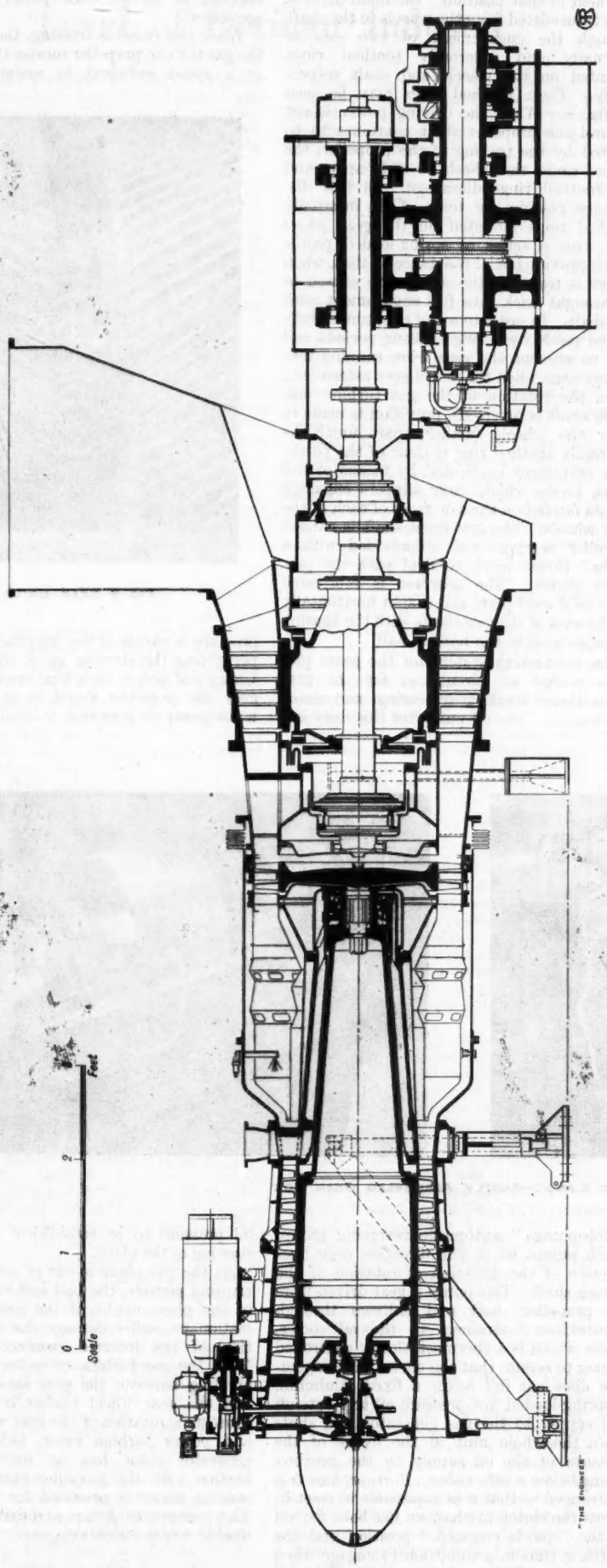


FIG. 3—GAS GENERATOR ROTOR

ARRANGEMENT OF GAS TURBINE MARINE PROPULSION UNIT

METROPOLITAN-VICKERS ELECTRICAL COMPANY LTD., TRAFFORD PARK, MANCHESTER, ENGINEERS



is taken from the forward end of the compressor shaft through bevel gearboxes and a vertical shaft.

The annular combustion chamber developed by Metropolitan-Vickers for jet propulsion engines is characterised by "straight-through" flow. The chamber consists of two concentric walls containing an annulus, within which is mounted an annular primary chamber consisting of inner and outer walls. Air entering the chamber from the compressor is divided; the smaller portion enters the primary chamber or zone of primary combustion through a series of holes on the upstream end of this chamber, and the larger part passes to the inner and outer annuli formed between the primary chamber and the containing walls. Pool gas oil is injected in a finely atomised stream into the primary chamber through twenty fixed orifice jets in an upstream direction. The high-temperature products of combustion in the primary chamber are then mixed with the remainder of the air, which enters the chamber through a number of slots in the inner and outer walls of the primary chamber, resulting in a mixture at a temperature suitable for the turbine inlet. The sheet metal portion of the combustion chamber is of "Immaculate 5" stainless steel, which has excellent heat resisting qualities and a coefficient of expansion approximating to that of aluminium alloy.

The two-stage turbine driving the compressor has a disc of molybdenum-vanadium steel carrying moving blading of "Nimonic 80" alloy. A stub shaft is forged integral with the disc and is splined and locked into the end piece of the conical extension of the compressor drum. Each side of the turbine disc is cooled by a flow of air from the centre radially outwards, the air being taken from the compressor outlet.

Power Turbine

The power turbine rotates independently of the compressor turbine. It has four stages with both fixed and moving blading of molybdenum-vanadium steel. The moving blades are mounted in axial serrations formed in a drum, also of molybdenum-vanadium steel, and the fixed blades are dovetailed into circumferential slots machined in the stator casing (shown in Fig. 2), which is made of forged mild steel. The drum is supported from the central shaft by two dished end pieces; that at the after end is secured rigidly to the shaft and that at the forward end is connected to the shaft through the medium of discs, which are flexible in an axial direction in order to deal with differential axial expansion of the drum and shaft. The shaft itself is carried in two ball bearings. The forward bearing is mounted in a spring-loaded housing which floats axially to deal with expansion; this housing is carried by a fabricated steel inlet branch through a number of struts of aerofoil section. The after bearing is similarly supported. A picture of the power turbine rotor is reproduced in Fig. 4, and Fig. 5 shows the lagged power turbine cylinder with its exhaust casing. The after bearing is designed to take the axial thrust on the blading and is mounted in a spherical seating, permitting slight angular movement. Both bearings are lubricated by oil mist and are air cooled in a manner similar to that used for the bearings of the compressor rotor, the oil supply being taken from the gas generator lubricating oil pump. The interior of the drum is cooled by a flow of air led through external pipes from the fifth stage of the compressor. The gas generator outer casing is connected to that of the turbine by means of a bellows type expansion piece. The hot gases on leaving

the power turbine are passed through an outlet volute of fabricated sheet steel which turns the flow in a vertical direction to the

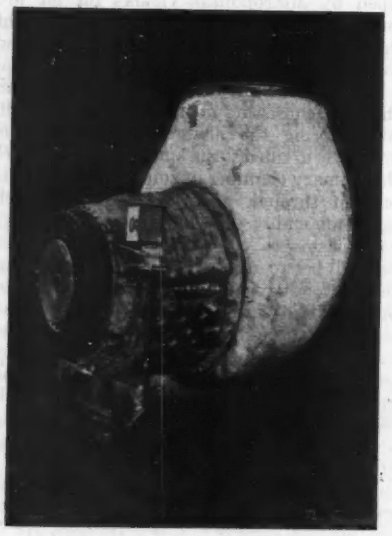


FIG. 5—POWER TURBINE

exhaust through the funnel that is the distinctive feature of the ship's silhouette.

SPEED REDUCTION GEAR

The gear is double-helical single-reduction. The drive from the power turbine is taken through a flexible quill shaft. This shaft passes through a hollow pinion, to which it is attached at the end remote from the turbine. The pinion is carried in roller bearings without axial location. Photographs reproduced in Figs. 6 and 7 show the gearbox partly assembled.

It was necessary to provide means to permit the gas turbine propeller to rotate idly when the reciprocating engines alone were in service and thus avoid motoring the power turbine rotor with consequent blade windage losses. To fulfil this purpose the gear incorporates a Sinclair self-synchronising clutch mechanism developed by the Hydraulic Coupling and Engineering Company, Ltd. The low-speed gear wheel is in two halves, with one helix formed on each, and both portions are free to slide axially on the shaft. The principle of operation of this mechanism is that loads on the driving teeth cause the two single helical wheels to be drawn together and held in that position; the main drive is then transmitted from the wheels to the shaft through the engagement of two sets of internally and externally toothed rings mounted on the wheels and shaft respectively. These toothed rings may be seen in Fig. 8. When the driving power is cut off and the propeller shaft continues to be rotated by the trailing of the propeller, the helices cause the wheels to slide apart and the toothed rings disengage. In this disengaged position the teeth of the internally toothed rings mounted on the gear wheel pass over a series of spring-loaded pawls, which provide initial resistance so that, when power is restored, the wheels are caused to be brought back into full engagement with the shaft. In order to avoid continuous duty of the pawls over long cruising periods and also to prevent the gear from running into engagement when the vessel goes astern (*i.e.*, when the rotation of the gas turbine propeller shaft is reversed), provision is made to draw the wheels further apart until the internally toothed ring is clear of the pawls. This movement is effected by means of bell crank levers which carry slippers engaging collars formed on the side faces of each of the gear wheels. The low-speed shaft is carried in roller bearings and is provided with a Michell thrust block to deal with the propeller thrust. The gearcase is fabricated from mild steel plate and is split horizontally on the axes of the two shafts with the bearing keeps secured to the bottom half.

The lubricating system for the gears provides cooled oil circulation for the gear teeth, thrust block, gear bearings and clutch mechanism. The oil pump for this duty is a "Rotoplunge" automatic reversing pump, which pumps oil in one direction only irrespective of the direction of rotation of the driving shaft. This pump is gear driven from the propeller shaft and delivers through "Autoklean" strainers to the oil cooler, across which is a thermostatically controlled bypass to ensure that the cooled oil temperature does not fall below a fixed minimum. A spring-loaded low-pressure oil trip cuts off fuel supply to the gas generator and shuts down the whole unit in the event of the pressure of the oil supply to the gearbox falling below a safe value. Further, this trip is arranged so that it is impossible to reset it, unless the clutch mechanism has been moved to the "pawls engaged" position and the clutch is thus in a condition to engage when power is applied to the gearbox. By such means the needless overspeeding and re-tripping of an unloaded power turbine is prevented.

When the vessel is cruising, the trailing of the gas turbine propeller rotates the oil pump at a speed sufficient to maintain an oil pressure in excess of the tripping pressure, so permitting the starting up of the gas plant. Under test bed or dock trial conditions, however, the propeller would be at rest, and a hand pump is provided to enable sufficient oil pressure to be established to allow the starting of the plant.

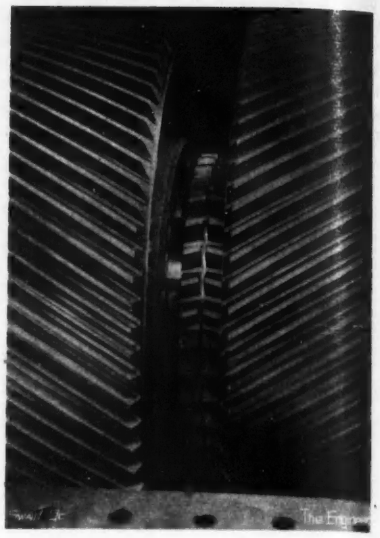
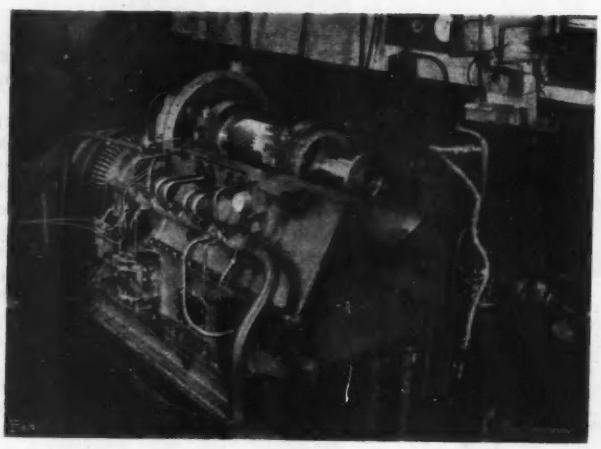
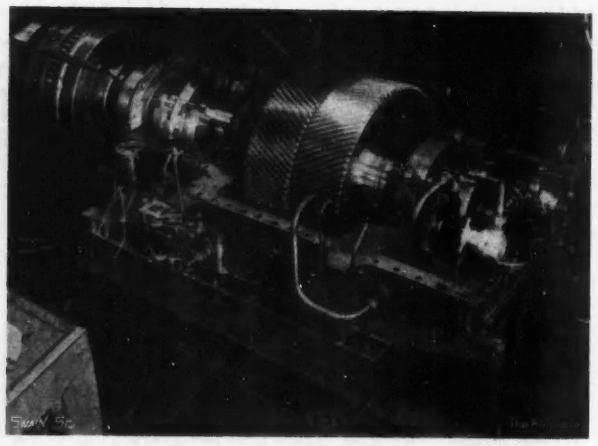


FIG. 8—GEAR DRIVE





FIGS. 6 AND 7—PARTLY ASSEMBLED GEAR BOX

As the gas plant is out of service for long cruising periods, the ball and roller bearings of the plant might, if the rotors remained stationary, suffer damage due to the vibration of the internal combustion engines. With the gas turbine propeller trailing, the oil drag between the gear slow-speed shaft and the gear wheel bushes is sufficient to cause slow rotation of the gear wheels, pinion and power turbine rotor, but as the gas generator rotor has no mechanical connection with the propeller shaft a separate inching motor is provided for this element. This motor is of $\frac{1}{16}$ h.p. and drives through a double worm reduction gear.

(To be continued)

Level of German Industry

THE revised plan for the level of industry in the British and American zones of Germany was issued at the end of last week. We give below the main points of the plan.

General Considerations

The industrial capacity retained under the March, 1946, plan was estimated to provide production equal to 55 per cent of 1938, which would have been about 70 per cent to 75 per cent of 1936 production. The effect of the new plan will be to retain sufficient capacity in the bizonal area to approximate the level of industry prevailing in Germany in 1936, a year that was not characterised by either boom or depressed conditions.

In developing the bizonal plan the overriding requirement has been to provide the level of industry necessary to make the area self-supporting. In determining the levels for the specific industries, for example, steel and machinery, the requirements for exports for the internal needs of the bizonal area and for trade with the rest of Germany have been taken into account. In evaluating the requirement for trade with the rest of Germany and of imports, account had to be taken of removals of capital equipment from the other zones and Berlin.

Requirement for a Balanced Economy

In addition to pre-war foreign trade, the bizonal area must produce a surplus over its internal requirements for trading with the remainder of Germany; this particularly affects requirements for the industrial capacity of steel and steel products, which are the most needed and therefore the most dependable trade commodities required by the rest of Germany in exchange for key products essential to the bizonal economy.

Change in Price Relationships.—World food and raw material prices have increased more rapidly than the prices of manufactured goods since 1936, and this situation seems likely to continue. Consequently, the bizonal area must be prepared to exchange in foreign trade proportionately larger quantities of industrial products in return for necessary food and raw material imports.

Imports.—In a general way, the bizonal area accounted for the whole of Germany's pre-war food deficit, as the remainder of Germany was about self-reliant in foodstuffs. It is estimated that imports of food, seed and fertiliser sufficient to make possible an essential diet will amount to 1·00 to 1·25 billion dollars at current prices.

Industrial imports from other countries to the bizonal area were approximately RM.1·5 billion in 1936, which represents at least 1·0 billion dollars at current prices. But the altered character of German trade will make it possible to reduce this figure.

The invisible items in Germany's foreign trade were approximately balanced before the war. The present calculations, which make no provision for invisibles on either side of the account, may be optimistic.

The foregoing conclusions lead to the conclusion that the total bizonal requirements from outside of Germany will approximate at least 2·0 billion dollars at current prices. Repayment of advances by the occupying powers would be an addition to these estimates.

Exports.—The 1936 exports from the bizonal area were approximately RM.2·6 billion, which is estimated to represent about 1·75 billion dollars at current prices.

These estimates, therefore, indicate that, in addition to trade requirements for the rest of Germany, the bizonal economy will need to export to other countries at least 15 per cent more in volume than in 1936. Since trade between the bizonal area and the rest of Germany is subject to greater uncertainty than former internal trade, the result may be to increase still further the need for trade with other countries.

Before the war, the broad fields of metals, machinery and chemicals accounted for two-thirds of the total exports. Production of textiles, ceramics, and consumer goods can be raised, but the extent to which additional sales above pre-war levels can be sold on the export markets is difficult to predict. Exports from the unrestricted industries would need to be increased approximately 90 per cent if the higher export requirements were provided entirely from the unrestricted industries, which is obviously impracticable. Therefore, the level of exports from the restricted industries will need to be greater than pre-war.

Increased Levels in Restricted Industries

The following determinations have been reached with respect to the industries restricted under the original Level of Industry Plan. (Note.—All figures stated in Reichsmarks refer to 1936 prices.)

Steel.—Under the March, 1946, Level of Industry Plan, steel capacity for all of Germany is limited to 7·5 million tons, with actual production in any single year not to exceed 5·8 million tons. Careful calculations show that this level would be clearly insufficient to even support the level of industry contemplated in the original plan, and it is far too low to provide for the needs of the economy under the revised plan. It has been determined that in order to support the revised level of industry in the bizonal area and to permit that area to become self supporting, the limit of annual steel production in the bizonal area shall be fixed at 10·7 million ingot tons per annum and sufficient capacity to produce that tonnage shall be retained.

Mechanical Engineering Industries.—Heavy Machinery Industry.—Sufficient capacity will be retained to produce RM.500,000,000 which is about 80 per cent of pre-war production. This leaves 35 per cent of the present capacity to be removed as reparations as against 60 per cent under the previous plan.

Light Machinery Industry.—The capacity in the bizonal area is estimated at about RM.1,195,000,000. Capacity will be retained to produce RM.916,000,000, which is 119 per cent of pre-war production. This leaves 23 per cent of present estimated capacity available for reparations, as compared with 35 per cent under the old plan.

(*Note.*—Grouping heavy and light machinery, the revised level is 105 per cent of pre-war production.)

Fine Mechanics and Optics.—In the field of precision optics, no plants will be made available for reparations. The capacity is to be retained to provide for internal needs and to attain exports of the same products equal to those from the bizonal area in 1936.

In the case of photo-technics, no plants are to be made available for reparations and the retained capacity will be used to attain 150 per cent of pre-war exports in this field from the bizonal area as well as to provide for internal requirements.

In the watch-making industry one plant, which had been converted to war use, will be made available for reparations.

Capacity in excess of pre-war will be retained in the field of precision mechanics. However, all plants which had been built for or substantially modified to war use will be made available for reparations.

Machine Tools.—The March, 1946, level of Industry Plan permits the production of RM.74,000,000 in all of Germany, or 11·4 per cent of 1938 output. The bizonal area, before the war, produced about 43 per cent of Germany's machine tools. Present capacity is estimated at RM.259,000,000. It has been determined that capacity sufficient to produce RM.170,000,000 must be retained in order to support the revised level of industry. This will leave about 35 per cent of present capacity for reparations.

Agriculture and Road Tractors.—Estimated bizonal capacity for agriculture and road tractors is 16,500. This is inadequate to meet bizonal requirements, which are estimated to be 19,500. Consequently, there will be no reparations in this industry.

Transportation Industries. — Automotive Industry.—Capacity will be retained for the production of 160,000 passenger cars and 61,500 commercial vehicles. This compares with 40,000 passenger cars and 38,000 commercial vehicles allotted to the bizonal area under the old plan.

Electrical Engineering.—The present capacity of the electrical industry in the bizonal area is required with the exception of three war-time plants. Capacity is estimated to be about one-half greater than pre-war. This increase is necessary because pre-war requirements of the bizonal area were in large part met from capacities in Berlin, which have been almost totally dismantled. Under the old plan, about one quarter of present bizonal capacity would have been removed.

Chemicals.—Approximately the 1936 capacity will be retained in the chemical industry, which is about 42 per cent more than that provided in the old plan. However, a large number of explosives and other chemical plants were developed for war purposes. Between 40 per cent and 50 per cent of the total chemical capacity, including war explosives, will, therefore, be removed as reparations or destroyed. More than three-quarters of such removals represent war explosive plants that have already been offered for reparations or declared for destruction.

For the plastics industry, capacity somewhat larger than pre-war will be retained. Approximately one-quarter of existing capacity of this industry will be made available for reparations.

Capacity for the production of 34,000 tons of dyestuffs will be retained, which is somewhat below pre-war. One plant will be available for reparations in this industry, with a capacity of 2500 tons of sulphur black dyes.

One pharmaceutical plant for the production of atabrine will be available for reparations. This will leave the bizonal area with a capacity equal to about 87 per cent of pre-war production.

In the miscellaneous chemical groups, a capacity greater than the pre-war level of production will be retained. About 15 per cent of the capacity will be available for reparations.

In the basic, organic and inorganic chemical industries, sufficient capacity will be retained to permit output at about pre-war levels. Not more than 17 per cent of present capacity will be removed as reparations.

Cement.—All of the cement capacity in the bizonal area is required and will be retained.

Electric Power.—Except for certain power stations attached to industrial plants scheduled for reparations under this plan, and power plants already allocated for reparations, no further removals will take place. In order to sustain the levels of production required by the bizonal economy, the present power plants in the bizonal area will have to be substantially repaired and replaced to meet the power requirements.

Non-Ferrous Metals.—The bizonal copper requirements are 93 per cent of estimated current refining capacity. Fabricating capacity for 215,000 tons of copper in the bizonal area will be retained, as compared with 140,000 tons for all of Germany under the old plan. This will make available for reparations one smelter plant and an appreciable quantity of fabrication facilities, including special pieces of equipment that are surplus to individual plants.

Prohibited Industries

The production of aluminium, beryllium, vanadium and magnesium is prohibited under the previous level of industry plan. No plants in these industries will be made available for reparations purposes pending further review. No change is proposed in the arrangements made under the previous plan in regard to ball bearings, synthetic ammonia, synthetic rubber, and synthetic gasoline and oil.

THE ENGINEER

SEPT. 5, 1947

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Contents

THE ENGINEER, September 5, 1947. PAGE

A SEVEN-DAY JOURNAL ... 211

LEADING ARTICLES—
THE FIRST GAS TURBINE AT SEA ... 222
F.B.I. AND T.U.C. ... 222

SPECIAL ARTICLES—
BRITISH ASSOCIATION. No. II ... 224
CUNARD WHITE STAR LINER "MEDIA." (Illus.) ... 227
ENGINEERING AND MARINE EXHIBITION AT OLYMPIA. No. II. (Illus.) ... 212
ENGINEER LOOKS AT CHILE. No. II. (Illus.) ... 226
GAS TURBINE PROPELLED "M.G.B. 2009." No. I. (Illus.) ... 218

FIELD TESTS ON 132KV CABLE INSTALLATION. (Illus.) 231
INTERNATIONAL CONTROL OF ATOMIC ENERGY ... 224
LEVEL OF GERMAN INDUSTRY ... 221
POWER SUPPLY FOR SOUTH AFRICAN MINES ... 230

LETTERS TO THE EDITOR—
SCALES OF REMUNERATION ... 226

LITERATURE—
BOOKS RECEIVED ... 224
SHORT NOTICES ... 224

OBITUARY—
ANDREW JOLLIE ... 223

NEWS AND NOTES—
FORTHCOMING ENGAGEMENTS ... 234
FRENCH ENGINEERING NEWS ... 238
INDUSTRIAL AND LABOUR NOTES ... 232
NOTES AND MEMORANDA ... 233
PERSONAL AND BUSINESS ... 234
REPORTS ON GERMAN AND JAPANESE INDUSTRY ... 234
TECHNICAL REPORTS ... 223

TWELVE-PAGE DESCRIPTIVE SUPPLEMENT. (No. II.) AND TWO-PAGE ART SUPPLEMENT—THE ENGINEERING AND MARINE EXHIBITION AT OLYMPIA.

NOTICE TO READERS

All letters intended for insertion in THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

For Subscription Rates, see page 2 of Advertisements.

THE FIRST GAS TURBINE AT SEA

JUST fifty years ago a strange new craft travelling at an unexampled speed aroused intense interest at the Spithead Review of H.M. Navy. The S.S. "Turbinia" was made by British hands to the design of a British engineer. It was the first ship at sea ever to be propelled by steam turbines. Last Friday we were privileged to take part in trials of another vessel in its way as historic as the "Turbinia." H.M. Motor Gunboat "No. 2009" is the first ship to be propelled at sea by a gas turbine. That turbine was again made by British hands to British designs. It develops 2500 s.h.p. and has been installed in the gunboat in place of one of the three 1250 h.p. Packard petrol engines with which it was originally equipped. Curiously, the speed of this modern vessel is closely comparable with that attained by the "Turbinia." But the only other resemblance between the two vessels, otherwise very different in form, is to be found in the fact that the great mass flow of air through the gas turbine has necessitated the provision upon the gunboat of a diminutive funnel, a strange addition to its otherwise familiar silhouette.

A complete description of the new plant is begun on another page of this issue. The gas turbine unit is intended only for use when the craft is required to travel at full speed. For cruising the remaining two Packard engines furnish sufficient power. The turbine was installed because for such a service it offered many important advantages. As was amply demonstrated during the trials, the gas turbine unit can, in case of need, be brought into service and placed on full power within a minute or two of the call for action, even if dead cold to start with. That short time contrasts sharply with the very much longer period required to warm up the petrol engines and obtain maximum power from them. Further, the turbine unit has more favourable torque characteristics, high torque being transmissible to the propeller at the lower speeds. This characteristic contrasts with that of the petrol engines, which can provide high torque only at high speed. Certain operational advantages follow, including improved ability to tow and greater ease and rapidity in reaching maximum speed. In such craft noise has to be accepted as the invariable accompaniment of high speed. Yet we formed the opinion that the gas turbine and its gears were appreciably less noisy than the engines, a factor not wholly without significance as affecting the fatigue of the crew. These advantages have already been proved in service. A further one which is reasonably expected is that of improved reliability and lesser demand for maintenance. Only longer experience in service will prove whether it is justifiable. Only longer experience, too, will be able to reveal what troubles, if any, are likely to arise in gas turbine design through the special peculiarities of marine service. One such trouble has already been anticipated. The great bulk flow of air through the turbine unit has necessitated the provision of a special intake duct leading to the compressor entry. To minimise the entry of spray, which could do serious damage were it to reach the compressor blades, the entrance to this duct is arranged abaft and below the bridge, the most sheltered position in the ship, and provision has been made to trap any spray that is sucked in. But the opportunity has not yet arisen, we understand, to put this arrangement to a test in really bad weather.

British engineers, and more particularly the Metrovick Company, can very rightly congratulate themselves and the Royal Navy upon being the first to install a gas turbine in a ship for its propulsion at sea. But it would be unwise to found too much optimism about the practicability of propelling more normal craft by gas turbine upon the apparent success of this first marine gas turbine unit. For this turbine is not the main propulsion unit. It is intended to be brought into use only when high speed is required and will not be used over long periods while the vessel is cruising. That fact has greatly influenced its design. Fuel economy, for instance, is not a matter of great importance, as may, indeed, be inferred from the high specific consumption figure of 1·06 lb per horsepower hour. Moreover, for such intermittent use the design considerations applying to the turbine approximate more closely to those appropriate for aircraft than to those ruling in other marine applications. A turbine designed for a relatively short life of a few thousand hours becomes quite satisfactory, whereas for the propulsion of more normal craft much more conservative ratings would have to rule. Further, it is to be noted that the gas generator portion of the present unit was not designed for sea service at all. It consists of a standard jet propulsion engine, the high pressure exhaust gases from which are directed into a specially designed propeller turbine instead of into a jet propulsion tube. Furthermore, no problem of providing for astern travel has arisen, since the petrol using engines are equipped for that duty. No doubt the Navy is experimenting with variable pitch propellers, which, if proved reliable, would provide a very satisfactory answer to that problem. It is indeed possible that quite apart from its particular value in conjunction with a gas turbine, the Navy may find that the variable pitch propeller has specially valuable qualities for improving the manœuvrability of high speed small craft such as that in which this gas turbine has been installed. But the fact remains that in the installation under consideration the particular problem of astern propulsion did not arise. There are then many problems of the application of the gas turbine to marine propulsion which this unit can do nothing to enlighten. For a fuller appreciation of the possibilities of the gas turbine at sea we must await the installation of a unit as the sole means of propelling a more normal sea-going craft such as the escort vessel which the Admiralty has already announced will be constructed.

F.B.I. AND T.U.C.

AT the end of the war the Government embarked upon an expansionist "full-employment" policy. As a part of that policy it stressed the need for the modernisation and re-equipment of industry and offered encouragement to works of this character which might help export industries to compete abroad. In the event, since there was in addition to this re-equipment of the export industries much overdue maintenance work to be undertaken and many houses and other works to be built, a manpower shortage developed. Until a fortnight ago it was relieved by the receipt of imports from abroad, for which payment was made through the American loan. But now, the support of the American loan being removed, that whole expansionist policy necessarily has to come under review. There is no difficulty whatever in deriving the conclusion that the answer to Britain's economic crisis is to reduce imports and encourage exports with the object of more nearly balancing our oversea deficit. But the transition from a conviction so easily reached to the formulation of a more defined policy is far more difficult. For it involves decision as to how the policy is to be implemented. Moreover it requires at least some reversal of those expansionist trends so far followed. For we cannot much longer depend upon imports unbalanced by exports to reduce the already excessive demands upon our limited manpower. It is not an easy pill for the Government to swallow.

It is, to-day, too often assumed that the manpower shortage can be broken only by calling upon all for ever harder work and greater output, by imposing more stringent controls upon industry, by adopting compulsion to direct labour into those indus-

tries most affected by the scarcity and by preventing the development of industries regarded as inessential. In fact, an alternative does exist. It is that of bringing down the targets for total production to levels more nearly in line with our real present productive capacity. That is the alternative which is recommended by the Federation of British Industries in a document published at the end of last week. It is, of course, not the only recommendation that body makes towards the formulation of a policy to meet the crisis. It is, for instance, pointed out that the prosperity of this country is closely linked up with that of some of its Continental neighbours; and it is consequently very rightly urged that "all possible steps should be taken to indicate the desire of the United Kingdom to arrive at a basis of collaboration with the nations of Europe," even to the extent of risking some unemployment here this winter by starting to export coal. The need, too, to increase our coal output, to expand production in certain industries and to sell more of our goods as exports is also stressed. But in considering the latter of those needs the Federation is forced back to its earlier conclusion that a heavy cut in the national programme of capital projects should be made. For, as against net national savings of £350 million per year, the total capital outlay is estimated at £1600 million, and after removing self-balancing items the national and local government share of this total is computed to be some £800 million. It is the resulting inflationary pressure, of course, that is driving up costs, as instanced by the recent rise in the price of coal and the coming increase in railway charges. The unfortunate consequence is twofold. Not only do increased costs make the sale of goods abroad more difficult in face of that competition that is already developing. The incentive to trade abroad is also lessened, since higher prices can be obtained in a home market starved of goods than in many export markets. The Federation feels that the "certain cutting down" of capital expenditure already envisaged by the Government is insufficient. A bold cut of the order of £450 million, designed more nearly to equate capital expenditure to national savings, is suggested. Further, the Federation expresses strongly the view of industry that there are to-day too many controls and that where they cannot be removed industry itself should be made responsible for their operation. It is by no means impossible, however, that one of the consequences of that heavy reduction in capital expenditure that the Federation recommends might prove, in the event, to be so significant a reduction in demand that many controls could at once be eliminated. Such a policy as that recommended by the F.B.I., in effect a policy of deflation, is one not easy for any Government, least of all a Labour one, to follow. For even though, since manpower is to-day in even shorter supply than it was before the American loan ran out, the risk that such a policy would create permanent unemployment seems remote, it would undoubtedly cause a very considerable change-over of employment as workers, withdrawn from the temporarily suspended capital operations, had to transfer to more essential occupations. Though that limited direction of labour, to which the unions have reluctantly found themselves forced to agree might no longer prove essential, some temporary unemployment would necessarily be created. Moreover, the early realisation of those appreciably higher living standards that the Government has set its heart upon giving to the people might be prejudiced.

Such, then, is the policy recommended by the Federation of British Industries, essentially a body representative of employers and managements. As we write, the annual congress of the T.U.C. is taking place at Southport. Will, we wonder, some similar policy emerge out of its discussions that might encourage the Government to more vigorous action than it has at present taken? We doubt it. It seems more likely that the trade union leaders will press for yet more planning, yet more controls and yet more compulsion; and that they will endeavour to shield their members from the economic consequences of Britain's plight by imposing tighter controls upon employers and upon employment. Such a policy conceals the realities of Britain's economic situation from the workers. It thereby makes possible irresponsible "unofficial" strikes such as that now spreading in the coal industry, strikes which are decided upon without consideration of their broader consequences and which seriously threaten to undermine this country's efforts to overcome its present difficulties.

Obituary

ANDREW JOLLIE

MANY of our readers with interests in the Sheffield steel industry will learn with regret of the death, on Friday, August 22nd, following an operation, of Mr. Andrew Jollie, who for the last twenty-five years of his life was chairman of Steel, Peach and Tozer, Ltd., and a director of the United Steel Companies, Ltd. Mr. Jollie retired in October, 1945, after half a century in the steel industry, and he died at his home at Coldingham, Berwickshire. Not only was Mr. Jollie a familiar figure in the Sheffield steel trade, but he was known throughout the whole of the industry. For many years he was a leader in the wheel, tyre and axle trades, and for some years he served as chairman of the National Association for Rolled and Re-rolled Steel Products, in the formation of which he took part. He was also Chairman of the Billet Associations, and it was through his wide knowledge and initiative that he was able to take such an active part in the reorganisation of the control of the steel industry. Mr. Jollie lived an active and strenuous life, and in his long experience he saw many changes in the steel industry, but he always had complete faith in the ability of that industry to weather the storms and overcome the difficulties which presented themselves. It is to be regretted that he did not live long enough to enjoy his well-earned retirement.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

SCALES OF REMUNERATION

SIR,—I cannot understand your leaderette of August 22nd, entitled "The Engineers' Guild," in which you state that a representative has been sent to that body by each of the great engineering institutions to co-operate in "such matters as status, fees, salaries, and so on," which "are outside their field." The general practice so far as I know is that each professional institution fixes scales of remuneration in its corporate capacity for its members. This practice is unimpeachable.

What is needed in the general interest is a Federation of the Professions, just as the trades unions are federated. One of the functions of such a Federation would be to appoint a suitable committee with appropriate sub-committees to supervise the scales of fees charged by all professional institutions.

A. W. CRAMPTON.

London, N.W.6.

Technical Reports

External Deposits on the Heating Surfaces of Boilers.—Technical Paper No. 1. By Dr. H. E. Crossley. Boiler Availability Committee.

The above title has been given to Technical Paper No. 1, issued by the Boiler Availability Committee, with the sub-title "Collected Experiences and Observations." The author of the paper is Dr. H. E. Crossley. It is stated that specialised reports are being issued as technical papers, to distinguish them from the more comprehensive reports which are issued as bulletins.

The paper summarises information on external deposits obtained by the author during visits to thirty-six British power stations, and this information is mainly the experience of the power station engineers. It has been arranged in thirteen sections.

The first section deals with the severity of deposits trouble in Britain, as indicated by the frequency of shut-down for boiler cleaning. It is stated that stoker-fired boilers commonly run only 1000 to 2000 hours before complete cleaning is necessary, although in some cases much longer runs are possible.

Five short sections follow, discussing boiler design, boiler rating, immunity to deposits trouble, boiler control and arbitrary outage. The seventh section gives opinions on the controversial subject of soot-blowing. These are mostly unfavourable, but it is pointed out that soot-blowing has received less attention where there is little trouble from external deposits.

The eighth and ninth sections are observations on the banking of boilers and the spacing between tubes or plates. These are followed by a discussion of fuel and combustion, with special reference to the significance of alkalis, sulphur and phosphorus in coals.

The paper ends with three sections dealing respectively with high temperature deposits, economiser deposits and air heater deposits.

Current Ratings of Cables in Ships, Second Report.—By E. E. Hutchings, B.Sc. (Eng.), A.M.I.E.E. Report Ref. F/T 164. The British Electrical and Allied Industries Research Association.

An investigation has been carried out to determine current ratings of single-core varnished cambric insulated plain lead-covered cables, in the same manner as described in Report Ref. F/T155. The results of the investigation are given in Part I of the present report.

Report Ref. F/T155 dealt with current ratings for groups of from two to eighteen rubber-insulated cables all of the same size and all carrying the same current. In practice, individual cables in large groups may be of different sizes, and generally carry different loads. The tests described in Part II of the present report deal with these aspects of the problem. The tests were carried out on rubber-insulated plain lead-covered (unbraided) cables carrying d.c., and installed in groups of eighteen, below a steel deck, as in the earlier investigation.

Review of E.R.A. Work on Overhead Lines (1920–1946).—Report Ref. F/T170. The British Electrical and Allied Industries Research Association.

The present report is a summary of researches carried out by the E.R.A. on overhead line materials and design during the twenty-six years from 1920 to 1946. The results may serve as a guide when considering the broad planning of future research. The report will also be of assistance when consideration is given to the compilation of a technical work of reference relating to special problems associated with overhead lines.

The report is divided into five major sections, which refer to conductors and conductor fittings, insulators, wind pressure, poles and foundations. Reports in the various subject groups are listed and the salient features of the researches are reviewed.

British Association

No. II—*continued from page 203, August 29th*

FOLLOWING the reading of the Presidential Address, on Thursday, August 28th, by Sir William Halcrow, two papers were read in Section G (Engineering) in amplification of the short section of the Address dealing with soil mechanics. Both authors are members of Sir William's firm.

Soil Mechanics

The author of the first paper, "An Analysis of the Position in Soil Mechanics," was Mr. N. J. Cochrane. He set out very briefly the present state of knowledge in this subject and pointed out some of the ways in which advances are being made, or may be made. For convenience, he divided soils into the coarse-grained or non-cohesive type and the fine-grained or cohesive type, adding that in actual fact the division is not sharp. One problem common to both is the estimation of stress distribution below a loaded area, and it was indicated how, mathematically, a general picture accurate enough for the purpose can be obtained. However, several important problems are not susceptible to close mathematical analysis, and if a close analysis is necessary where complicated load systems are involved, the only practical approaches open are by two or three-dimensional photo-elastic analysis, or by using Saint Venant's distant boundary principle and then applying Professor Southwell's relaxation methods. In general, non-cohesive granular materials do not present insoluble problems to the engineer. Settlement under load is usually small and quickly complete and its general characteristics are so well known that they were not repeated in the paper. It was pointed out, however, that there are certain phenomena and techniques which are not so well known or understood and the range of usefulness of which may be far from exhausted. Some of the biggest problems in handling coarse-grained materials are in dealing with water. When water-retaining structures are involved, the percolation of water round the structure may have to be considered. This is susceptible to mathematical flow net analysis; but, as the laws of hydraulic seepage are analogous to those of electrical flow, it is advantageous in some cases to use electro-potential experimental methods. Indeed, where questions of design are concerned the simplicity and flexibility of the electrical method has many advantages and can give both qualitative and quantitative results.

If a waterproof screen is required, and it is not possible to deal with the problem by pumping, the injection of chemicals, usually sodium silicate and calcium chloride, is effective, whilst the injection of finely divided bituminous materials has been found successful in clogging the pores of the soil. It has also been possible to synthesise resins *in situ* on soil particles.

Another range of problems is in the consolidation of filling to form the sub-grades of roads, runways, &c. In this country, as in America, the required compaction is obtained by what must be classed as methods of force, in that it requires the use of heavy rollers, some metal-surfaced, some rubber-tyred and some sheep's-footed. The ever-increasing load demands have resulted in ever-increasing sizes of rollers, and some of the latest American rollers range up to 200 tons in weight—water ballasted. There are other and easier ways of achieving compaction of materials, and methods of vibration have been developed in Germany to a considerable extent. Technical information is not yet easily obtainable on the Degebo investigations on sandy fills, but it appears that the action is not very sensitive. There is still work to be done on the technique, but in view of the possibilities, the author does not think it has received sufficient attention in Britain and America, although there have been sporadic investigations.

In fine-grain cohesive materials the civil engineer meets some of his greatest problems, and a large part of soil mechanics research has been devoted to their solution. It is now possible to forecast settlements under load and analyse the stability of some types of load systems with reasonable accuracy. It is necessary, however, to have a clear idea of the general formation and structure of clays if the material is to be controlled in a positive manner. There are, said the author, two types of control: either we accept the material as we find it and design the foundation of our structures so as not to overstrain the material, or to devise some method of strengthening the natural material. The former alternative is the normal process at present and often involves an enormous economic burden. The latter alternative is uncommon in this country. More than ten years ago certain interesting research work began to be published. The war ate up much of the intervening period, but the researches of Dr. Leo Casagrande—a German scientist now working in this country—are now available here.

In conclusion, the author expressed the view that the time lag between the demonstration of a useful process in the laboratory and its development on practical problems is still too long, and bearing in mind the expense inherent in our present handling of the soft cohesive soils, he suggests that thought should be given to the economics of some of the methods mentioned in the paper. A considerable amount of laboratory work has still to be done, but already there have been promising results.

A vote of thanks was accorded the author.

Dry Docks

The second paper was entitled "The Development of Dry Docks," the author being Mr. H. Ridehalgh. It deals with the history of the development of dry docks, but expresses some interesting views on future development. Information is given about the gradual development of dry docks up to the most recently constructed docks at Sydney and Cape Town, which, the author said, had been designed to handle the largest vessels, naval and merchant, visualised by those in authority as likely to be constructed in the next twenty years or so. The author said that a feature common to both docks was that the walls had become almost vertical and the altars, instead of being formed in the walls themselves, were wide and cantilevered out from the face. The use of cantilever altars might eventually be justified in practice, but it was suggested that they must be liable to damage from vessels docking, unless protected, and would offer obstruction to floating shores, catamarans and rafts during flooding up and pumping down. There were, however, attendant advantages, notably in design, where it was more easily possible to keep the resultant pressure back towards the heel of the wall than in the more normal wall with a stepped face. At Tilbury, there was a tendency to abolish the altars by building a large height of the walls with a plain vertical face, relying on hydraulic bilge blocks to replace the more normal shores, whereas at Southampton, mechanical shores had been preferred. The variety of present-day ship sections, particularly naval, might demand special arrangements for blocking and shoring, but it was not inconceivable that with the tendency to abolish the altar we should also eventually lose the mechanical shores in favour of the hydraulic bilge blocks and plain wall. The bilge blocks appeared to take up considerable floor space and their use for vessels of varying beam seemed a most delicate operation, but in actual practice they were extremely simple to use, the resultant unrestricted working space between the ship's side and the dock wall offering considerable advantages.

In the case of the newest docks, the length-entrance ratio had fallen to 8 : 1, whilst the length-cill depth ratio had remained at 26 : 1, though after reviewing the increases which had taken place during this century, it would be unwise to presume that maximum dimensions had been reached; yet it would nevertheless appear that the depths of navigable channels available in the main ports and canals throughout the world might soon limit substantial increases for some years unless considerable new and continued maintenance dredging was proceeded with.

On the subject of design, the author agreed that the theory of the use of the inverted arch in the floor to resist hydraulic uplift was perfectly sound, but in practice he said there had been many partial failures. The word "partial" was used because the failure did not represent the collapse of the arch as such, but of the lifting of the upper portion of it due to full water head being in many cases resisted by a completely impervious paving course laid on the main mass of the floor. The floor was designed (*a*) so that its thickness would contain the necessary arch rise, and (*b*) so that it would distribute the very heavy keelblock loads over the substrata. In most instances, and particularly in the wider docks, the former was the ruling case, but a more economical solution would appear to be to achieve, first, keel-load distribution and then adequately vent the floor to relieve water pressure.

There could be considerable saving in cost during entrance construction without loss of efficiency if the provision of granite quoins, dressed and polished to extremely fine limits, as had been the almost universal practice hitherto, could be abolished in favour of some combination of flexible seal on the caisson and simple and less exacting detailing of the masonry meeting face itself.

Remarking that dock engineering was one of the most interesting branches of the profession, the author said that in his relatively brief career it had become abundantly clear that opportunity exists for revising some of the long-standing ideas of what are essential provisions in dry dock works. Many details connected with design, construction and operation of dry docks had been perpetuated simply because they were provided and had been successful in the last dock the particular engineer designed, or because the dock-operating staff were familiar with the particular features for so many years that their omission or amendment in any new structure would compel them to start learning anew. It could be understood why owners were reluctant to permit an engineer to try out new proposals at his (the owner's) expense and risk, but providing the engineer was himself satisfied of the soundness of his proposals, no doubt a statement of the financial

as well as the operational advantages would assist in persuading the owner to forsake his forefathers and proceed along the line of progress.

The President said he thought the author was correct when he said it was chiefly the dock owner who was conservative and did not want any "new-fangled" notions.

The author was cordially thanked at the close of the discussion, and the section adjourned until the following (Friday) morning.

Nuclear Power

There was a discussion in Section A on Thursday morning on "Peacetime Applications of Nuclear Fission," in which many of the leading workers in this field took part. The discussion was opened by Sir Edward Appleton, F.R.S., who emphasised that applications of atomic energy are more important both to science and humanity than any other recent development of science. No scientific subject had ever aroused the same mixture of fears and hopes. Nuclear fission, he said, was not only a source of useful energy, but was a phenomenon which was giving rise to new experimental testing to assist investigators in various fields of science, such as physiology, biology, chemistry, metallurgy and in other directions.

Professor J. D. Cockcroft, Director of the Atomic Energy Research Department at Harwell, said it was probable that experimental power plants of a general type would be built within the next five years to begin Britain's first operative experience of nuclear power generators. Repeating much that he has already said in lectures on this subject, Professor Cockcroft gave the warning that, whilst nuclear power presented a rather dazzling prospect and was worth a determined attack, its future was by no means clear. The immediate and certain benefits from nuclear energy would come from the production of radio-active isotopes and from the use of nuclear reactors in scientific research. The application to power generators was much more uncertain and it would require at least five years before it would be possible to make a better prediction of its importance. If Nature were exceptionally kind, a reactor containing 100 tons of uranium would generate 100,000kW of thermal energy for twenty years without fuel replacement. One ton of uranium or plutonium destroyed by fission could provide a heat equivalent to 3,000,000 tons of coal; but there was a major uncertainty, and that was the safe disposal of the very large quantities of radio-active material that would be produced, and that required a very cautious approach. Moreover, in power production it would be necessary to withdraw the metal at frequent intervals, extract the fission products and reprocess the uranium or plutonium. Until operational experience told how frequently this could be done, they were in no position to predict the costs of nuclear power.

International Control of Atomic Energy

The Executive Committee of the Association of Scientific Workers issued at the end of August a statement on the International Control of Atomic Energy. It does not share the prevailing pessimism concerning the outcome of the present discussions on international control, which it regards as essential, and it sees no insuperable technical obstacles in the way of establishing such control. The statement goes on to analyse the urgency of international control, and states that such control cannot be considered in isolation from other political questions. It points out that perfect security for all nations may not be obtainable and emphasises the view that no international agreement is possible without the adherence of both America and Russia. Discussing the possibility of agreement, it holds that a wide measure of agreement already exists, and that points of disagreement can be adjusted by compromise. Such factors in the situation as the outlawing of atomic weapons, the dismantling of stocks, international control, inspection, and the unanimity rule are discussed, after which lines for future action are laid down. It is stated that when an effective system of international control is functioning there should be no more secrets of any kind about atomic energy, whether concerning fundamental phenomena, industrial, medical or military applications. Even at the stage before the conclusion of an international agreement, it would be helpful, it states, if secrecy restrictions were to be lifted over all fields covering fundamental phenomena and industrial and medical applications, secrecy with respect to military applications being in its view alone justifiable at present. Agreement would, it states, be easier if the framework of negotiations were to be extended. With regard to the British contributions to the solution of the international control problem, the Association holds that the *rôle* taken by the United Kingdom has so far been almost entirely negative. As a constructive contribution to the improvement of the international atmosphere, it urges the immediate declaration that this country intends, immediately, to lift the secrecy from all aspects of atomic energy research, except those related directly to military security. In particular, it suggests all information concerning atomic research in the field of fundamental physics and of the industrial and medical applications of atomic energy should be released by publication. By making such a declaration the British Government would, it is believed, help to provide the moral leadership in this field that is at present needed desperately by the whole world.

Literature

SHORT NOTICES

The Fordell Railway. By J. C. and F. Inglis. Published by Dr. J. C. Inglis, at the Colony, Larbert, Stirlingshire. 1947. Price 4s. post free.—In this pamphlet the authors describe conscientiously the Fordell Railway since its inception as a wooden wagonway in 1770 up to 1946, when as a normal railway its existence of nearly 180 years came to an end. Like all the wagonways, it was built originally for the conveyance of coal; in this case from the pit at Fordell or Coaltown and Cuttlehill to St, David's, which lies almost in the shadow of the Forth Bridge. Its length was about 4 miles—subsequently extended to 6 miles—and it carried about 30,000 tons of coal annually in 48-cwt wagons. Haulage was, of course, by horses, and some of the gradients were severe, as much as 1 : 13 at Vantage, but fortunately that was "with the load," though gradients as much as 1 : 90 against the load existed. In the early part of the last century, Robert Stephenson—printed Stevenson—submitted a plan for a malleable iron road, but it was deemed too costly, and a simpler one drawn up by the manager of the mines was adopted in 1832. It had two self-acting inclines, four empty wagons hauling up two full ones. The cost of operating the line was thereby reduced to one-third, and the weight of coals conveyed rose to 50,000 tons a year. In 1867 it was decided to use locomotives on the line. The first, built by Hawthorn and Co., of Leith, is believed to have been a simple four-wheeler on a 6ft wheel base, with two 11in outside cylinders. All the engines belonging to the company were 0–4–0 saddle tanks, the latest, dating from 1901, by Andrew Barclay, Sons and Co., of Kilmarnock. The line was dismantled in 1946. This pamphlet gives not only a very painstaking description of the line and its rolling stock, but is well illustrated with half-tones and maps. It forms an interesting chapter in Scottish railway history.

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The Engineer in Society. By John Mills. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 14s.

Sound. Fourth edition. By E. G. Richardson, London: Edward Arnold and Co., 41, Maddox Street, W.1. Price 18s.

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The Metallisation of Plastics. By J. R. I. Hepburn. London: Cleaver-Hume Press, Ltd., 42A, South Audley Street, W.1. Price 6s.

Applied Thermodynamics. By A. C. Walshaw. London: Blackie and Son, Ltd., 66, Chandos Place, W.C.2. Price 30s.

A Practical Theory of Mechanisms. By Paul Grodzinski. Manchester: Emmott and Co., Ltd., 31, King Street West. Price 7s. 6d.

Light, Vision and Seeing. By Matthew Luckiesh. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 25s.

Hand Tools. By Albert M. Wagener and Harlan R. Arthur. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 10s. 6d.

Light Metals in Structural Engineering. By L. Dudley. London: Temple Press, Ltd., Bowling Green Lane, E.C.1. Price 30s.

Elements of Radio. Second edition. By Charles I. Hellman. London: Macmillan and Co., Ltd., St. Martin's Street, W.C.2. Price 14s.

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Factory Costing and Organisation. Third edition. By H. H. Emsley. London: Constable and Co., Ltd., 10, Orange Street, W.C.2. Price 7s. 6d.

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Experimental Workshop Science. By W. J. Peck and G. T. Chawner. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 6s.

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Materials-Handling Equipment. By Matthew W. Potts. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway. W.C.2. Price 17s. 6d.

Road Making and Road Using. Third edition. By T. Salkield. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 12s. 6d.

An Engineer Looks at Chile

By ROLT HAMMOND, A.C.G.I., A.M.I.C.E.

(No. II—*Continued from page 194, August 29th*)

Chilean Nitrate

SINCE the year 1830, natural nitrate of soda has been exported from Chile, and in eighty-six years the output increased from 3000 to 3,000,000 tons per annum. For many years, in fact, the Chilean deposits in the *pampa salitrera*, or nitrate desert, were the only nitrogenous fertilisers available. Chilean nitrate has a nitrogen content of 16 per cent in a sodium base; nitrogen is a vital plant food, and with the intensive cultivation now necessary to support the growing populations of the world Chilean nitrate comes to the aid of nature in renewing soil fertility.

Tubbs* has referred to the presence of many other elements besides nitrogen and sodium, such as iodine, boron, magnesium and aluminium, which were isolated and analysed as long ago as 1840. These elements were understood to be relatively unimportant, but during the past twenty years their real significance has been fully appreciated. Agricultural research workers throughout the world have revealed the many valuable properties of these secondary materials.

The main food materials for human nutrition are proteins, fats and carbohydrates, but they are not enough without additional vitamins. In the plant world nitrogen, phosphorus and potassium are not sufficient in themselves to give good, healthy crops. It has been found that plants also need boron, magnesium, manganese, copper, zinc and other elements to ensure vigorous natural development.

Studies of the effects of the secondary elements referred to above have proved that boron is essential to fifteen plant species tested, and that the boron present in Chilean nitrate is adequate for the needs of all the species tested. Tubbs points out that the natural occurrence of these secondary elements in the Chilean product imparts to the latter a great advantage over the many synthetic fertilisers which have come on the market in recent years.

In addition to its great value as a fertiliser, Chilean nitrate has also many industrial uses, ranging from the manufacture of explosives to the curing of meat; it is also used for the manufacture of glass and enamel and for the production of saltpetre. But the industrial applications of Chilean nitrate are relatively unimportant when compared with the large quantity used for crop fertilisation. The nitrate trade in Chile was severely dislocated by the war, but now there should be a great demand for this vital material. The modern product from the nitrate fields is much better than that of former times, containing more nitrogen and being more convenient to handle.

* "Plant Food from the Chilean Desert," by C. G Tubbs, in *The Latin-American World* for January, 1945.

Origin of Nitrate Fields

The nitrate fields of Chile are one of the paradoxes of Nature, for from this barren land comes life-giving plant food formed during an immense epoch of geological time. In fact, there is a fascinating mystery about the formation of Chilean nitrate. Several theories have been put forward from time to time, including the actions of guano; seaweed, bacteria, electricity, and volcanoes.

The guano theory presupposes the existence, millions of years ago, of a large saline sea, on the shores of which vast flocks of sea birds caused huge accumulations of bird droppings, similar to those found in the guano islands of Peru. Dead bodies of birds and animals were lodged in these deposits, thus further enriching them; with the slow passage of geological time, the salt water reacted on the guano to form nitrate of soda. Following this period of deposition, it was assumed that volcanic action resulted in the ancient sea beaches being cast up far into the surrounding mountains.

The inherent weakness of this theory lies in the fact that the deposits do not contain any phosphates, which are always found in guano and in the decayed bodies of animals and birds; moreover, it certainly leaves unexplained the presence of considerable quantities of iodine, in which Chilean nitrate is very rich.

The presence of iodine squares admirably with the seaweed theory of formation, which also assumed a huge sea, isolated when volcanic upheavals created the Chilean tableland; with evaporation of water and subsequent decomposition, the nitrate beds were formed.

Pasteur discovered that nitrates can be produced by bacterial action, which led to the theory that Chilean nitrate deposits might have been formed in ancient times by drainage water collecting nitrates from the whole district, the coastal hills making the tableland an extensive settling tank in which they were deposited.

The electric theory is based on the supposition that the nitrates were formed by oxidation of nitrogen in the air through electrostatic tension accompanying the fogs which frequently lie like a blanket over the nitrate desert. Finally, the volcanic theory is founded on the argument that most of the known constituents of the Chilean nitrate beds have been found in the lava, stones and ashes cast up by active volcanoes like Vesuvius; the presence of boric acid in Chilean nitrate is advanced in support of this argument.

Exploitation of Nitrate

It is remarkable that for some three centuries following the European occupation of Chile, the nitrate riches remained unexplored and unexploited; there is a tradition that two Indians, in about the year 1730, wearied by travelling through this desolate region, lit a fire to warm themselves and noticed with surprise that the earth around the fire was sizzling and emitting blue sparks. To their primitive minds this was a manifestation of the Devil, and in mortal fear they fled to the neighbouring town of Camiña, where they knew that the priest would exorcise this evil influence. The priest, armed with a bottle of holy water, ordered the Indians to follow him to the scene of their strange experience; undaunted, he collected some of the material, analysed it, and found that it contained saltpetre, which he knew to be a constituent of gunpowder. After having allayed the fears of the Indians, he threw the remainder of the material on to a little used part of his garden, where he was amazed to see that the plants grew more vigorously and were healthier than any of the others. Being a keen gardener, he popularised the use of "caliche," the raw material from which Chilean nitrate is derived, and thus founded one of the world's great industries.

A further important step in the exploitation of Chilean nitrate was taken when a Spanish expedition sailed from Cadiz in 1788, numbering in its complement the

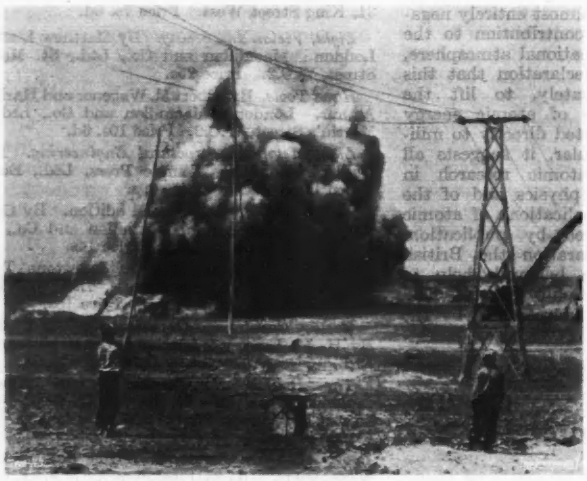


FIG. 1—FIRING CHARGE IN NITRATE FIELD

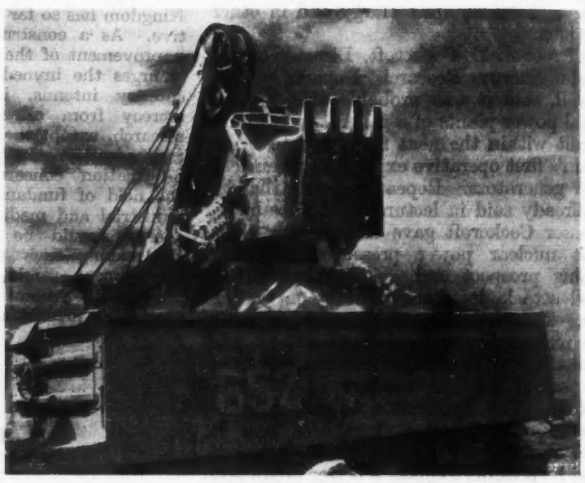


FIG. 2—LOADING CALICHE AT THE MINE

celebrated naturalist, Thadeus Haenke, a Bohemian who had been educated at the Universities of Prague and Vienna. Five years later the expedition visited Callao, the port of Lima; Haenke, who was ill, was left ashore and in search of health he journeyed to Concepción, where he wrote extensively about the fertilising riches of that district. He claimed to have been the first to carry out a complete analysis of the caliche and to extract nitrate from raw material found in Tarapaca; between 1810 and 1812 seven or eight small centres for the extraction of nitrate of soda under the direction of Haenke were established, the total export for that period amounting to some 2300 tons.

There are four distinct strata in the nitrate fields; the top layer, known as "chuca," is generally not more than ten inches thick. This layer has been formed by the decomposition of porphyry, its colour varying from grey to brown. The second layer, termed "costra," is several times thicker than the top layer and is much harder to break; it comprises clay, gravel, porphyry and feldspar, compacted into a hard, resistant mass by sulphate of calcium, chloride of sodium, nitrate of soda, and other elements. It can be broken up only with the aid of explosives. The valuable nitrate of soda is contained in the caliche, which forms the third stratum; the fourth and bottom layer, known as "coba," is composed of sand, various salts with underlying calcium sulphate, and clay. Beneath lies the bedrock of the country.

The third, or nitrate bearing stratum, varies in colour and composition from field to field; the nitrate desert is found on a tableland about 3000ft above sea level, covering an area about 500 miles long and less than 100 miles wide. The nitrate fields are concentrated on a long, narrow strip of land about 300 miles long and about 20 miles wide. The beds are very irregular in their formation, being separated by desolate stretches of barren ground, where no nitrate ore exists. In this grim and forbidding land, only once in three or four years is any suspicion of a rain cloud seen overhead; the clouds, moving westward over the Atlantic Ocean and the South American mainland, lose the greater part of their moisture in passing over Brazil and Argentina. That which remains is deposited on the towering barrier of the Andes, and thus the life-giving desert itself remains barren and devoid of animal life.

Nearly 50,000 workers are directly employed in the nitrate industry, which supports, either directly or indirectly, some 250,000 inhabitants of the region; the operations are directed by a large staff of civil, mechanical, mining and electrical engineers, geologists and chemists; all the food and water for this population must be brought from afar.

	(1) Per cent.	(2) Per cent.
Nitrate of soda	35·0	21·5
Nitrate of potash	1·0	1·0
Chloride of sodium—		
Common salt	32·0	40·0
Sulphate of sodium—		
Glauber's salts	8·0	2·0
Sulphate of lime	5·0	4·5
Sulphate of magnesium		
Epsom salts	1·0	Trace
Iodate of sodium	0·15	0·08
Insoluble matter, &c.	16·05	29·92
Moisture	1·8	1·0

The nitrate content of the caliche from which this valuable chemical is extracted varies from as low as 7 to 8 per cent, to as much as 75 to 80 per cent. Normally, it is white or grey in colour, but it may sometimes be violet, yellow, green or red, owing to the presence of impurities. The depth of the stratum varies from a minimum of 18in up to a maximum of from 12ft to 15ft. The accompanying table gives the analysis of two typical samples of caliche.

Chilean nitrate is available in two forms—crystalline and granulated. They have equal fertilising value, but they differ in appearance one from another and the processes for extracting the two types are quite distinct.

The caliche is mined by means of hand or compressed air drills, bore-holes being sunk through the overlying "chuca" and "costra" to a level beneath the caliche and are blasted by means of black-powder charges fired by time fuses. Fig. 1 shows a black-powder charge being fired electrically; 5000 lb of powder are used for blasting 10,000 tons of caliche. The waste material is then carefully separated from the caliche, and the large boulders are broken up by means of iron bars with steel points. After cleaning, samples are tested by inspectors to determine the nitrate content; a small quantity of caliche is sprinkled on a lighted wick. The greater the fire produced, the greater the nitrate content of the caliche; these inspectors are so highly skilled in their work that by means of this simple test they can gauge the nitrate content of a sample to within two or three per cent of the result which would be given by the most careful scientific analysis.

The caliche is then piled in rectangular stacks for measurement, the basis of payment being the number of cubic metres of ore which have been mined. Usually mining is carried out on an opencast system by means of trenches, but when the stratum is at a depth of fifteen feet or over, it is mined by underground methods, starting from a shaft. Pillars of the material are left at intervals to support the roof, the ore being raised to the surface by mule power. The ore is then removed to the "oficinas" or refineries, where the nitrate is extracted from it.

In only a few cases is the ore transported by rail. It is generally loaded on to mule carts or motor lorries, in which it is carried to the loading platforms, where temporary narrow-gauge railways are waiting to receive it. In Fig. 2 is shown a mechanical shovel loading a railway car with caliche.

(To be continued)

Cunard White Star Liner "Media"

WE were recently invited by the Cunard White Star, Ltd., to inspect the new North Atlantic liner "Media," shortly before she sailed from Liverpool on her maiden voyage to New York, on Wednesday, August 20th. The ship has now completed a successful outward voyage. The keel was laid in the yard of her builders, John Brown and Co., Ltd., Clydebank, on November 12, 1945, and the liner was launched on December 12, 1946, the naming ceremony being performed by Mrs. Barnes, the wife of the Minister of Transport. Successful trials took place in the early part of August, in the Firth of Clyde, and performance in excess of the contract service speed was recorded.

The principal hull dimensions and particulars of the propelling and auxiliary generating plant are given in the following table:—

Hull Dimensions and Particulars

Length overall	534ft
Length between perpendiculars	500ft
Extreme breadth	70ft
Loaded draught	30ft 2½in
Gross tonnage	13,700 tons
Net tonnage, about	7,482 tons
Designed service speed	17 knots
Number of passengers	251
Officers and crew	184
General cargo capacity	371,430 cu ft
Insulated cargo capacity	60,050 cu ft

Propelling Machinery

Engines	Twin-screw geared turbine, impulse-reaction H.P., all-reaction L.P.
Service power, about	13,600 s.h.p.
Maximum power, approx.	15,000 s.h.p.
Boilers	Two Yarrow side-fired type
Steam pressure at superheater outlet	430 lb per sq in
Steam temperature	750 deg. Fah.

Auxiliary Generating Plant

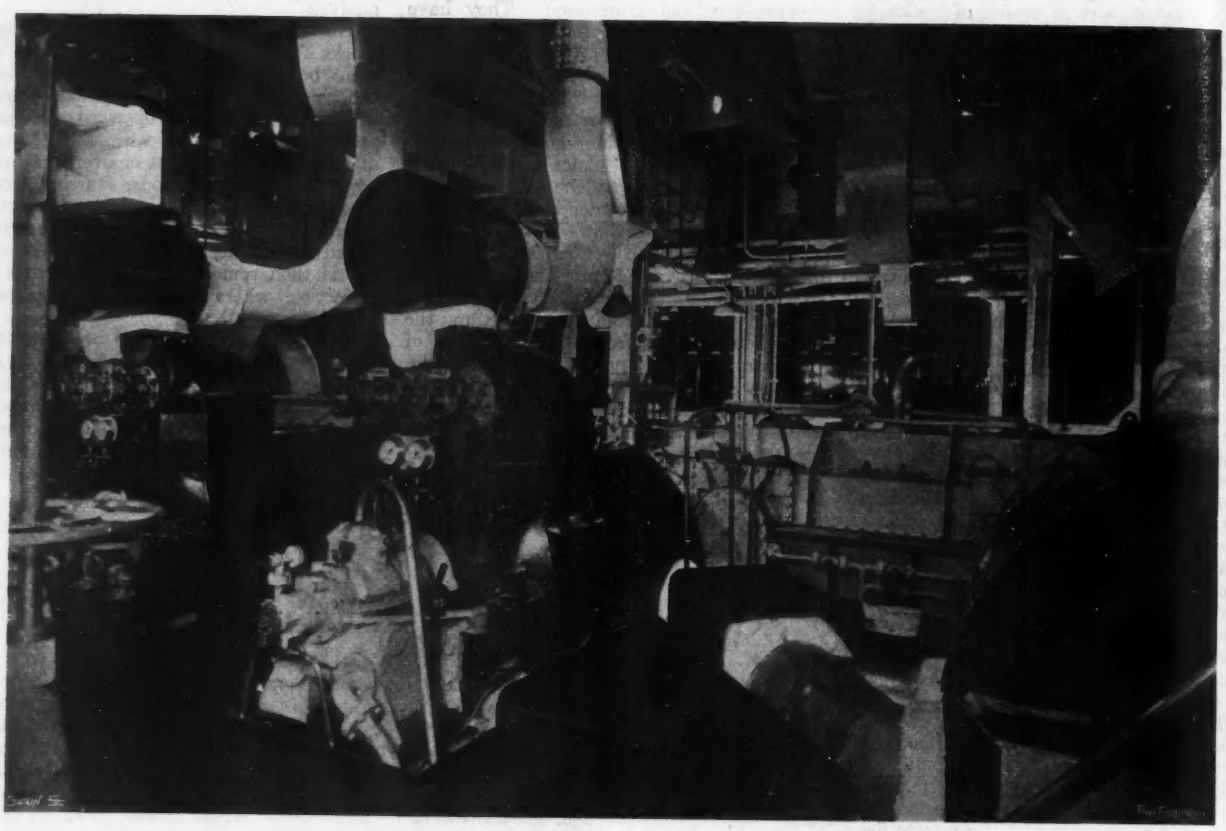
Engines	Four Ruston and Hornsby oil engines
Designed output each engine	630 b.h.p.
Running speed	500 r.p.m.
Number of cylinders, each engine	Seven
Generators	G.E.C.
Designed output, each generator	375kW
Voltage	220
Emergency set	50kW

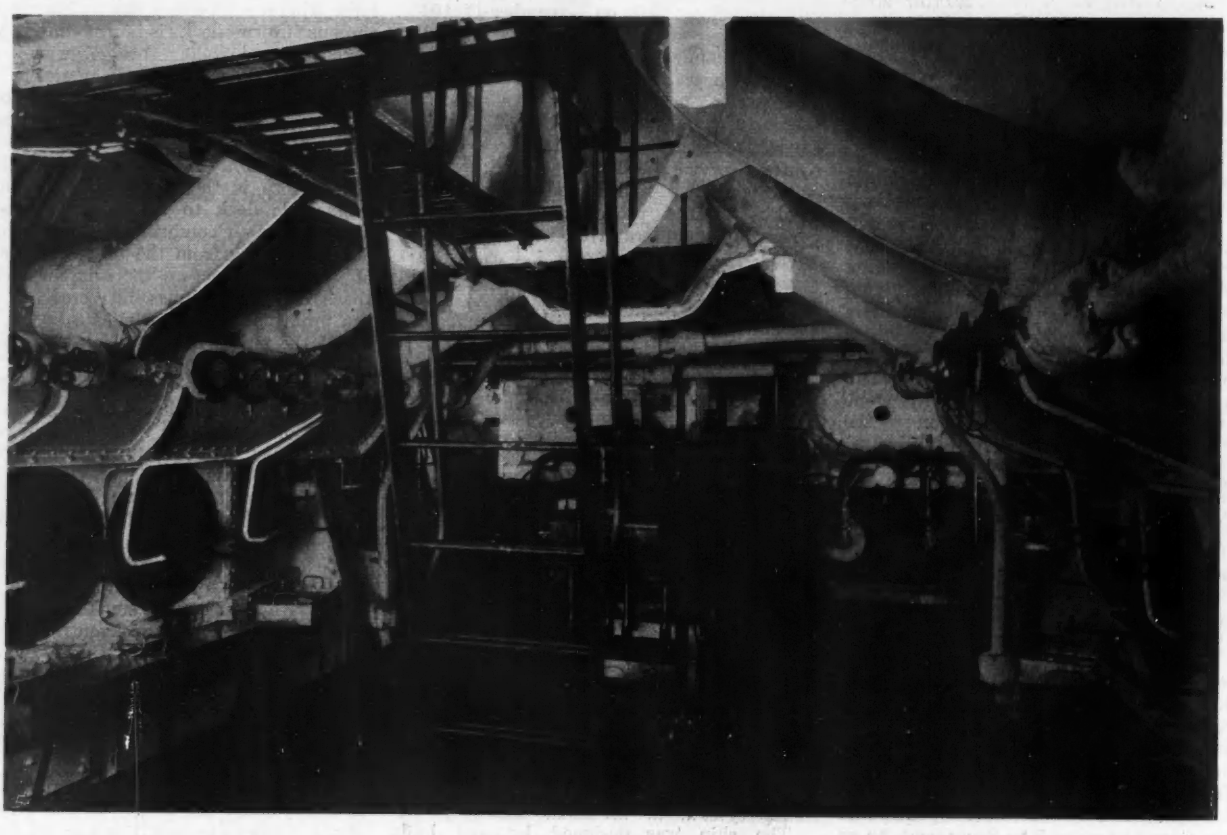
The ship was designed by and built under the supervision of Goodwin-Hamilton and Adamson, Ltd., consulting naval architects and marine engineers, Cunard Building, Liverpool. This firm is also acting in a similar capacity for the construction of the sister liner "Parthia," now building at Harland and Wolff's yard at Belfast. As our illustration shows, the "Media" has a raked curved stem, and cruiser stern with a single mast and funnel. The streamlined superstructure is curved at the forward end, and it embodies a continuous promenade, with large windows on either side, while the continuous upper deck is surmounted by a forecastle and a long bridge, with superimposed promenade and boat decks. The the number of passengers is limited to 250 in one class and the designers have aimed at compactness in the single class passenger accommodation. A new feature in liners of this size is the devoting of the entire promenade deck to the public rooms, all of which are air conditioned. On the bridge deck extending from the bridge to the end of the superstructure there is considerable space reserved for games and recreation, while the promenade deck includes a sports deck aft of the public rooms, which has a length of 50ft in the fore and aft direction. The passenger accommodation is arranged on "A" and "B" decks, and there is a high proportion of outside cabins all of which are provided with private baths or showers.

In the accompanying engravings we show one of the public rooms and a cabin. The smoking room is at the forward end of the promenade deck, and is curved to follow the shape of the bridge, with windows looking over the bows of the ship and the sides. From the entrance to the smoking room amidships, the promenade deck entrance hall is reached, on the starboard side of which is a cocktail bar and, on the port side the long gallery. Midway through the long gallery is an entrance to the drawing-room and library, a view of which we reproduce overleaf.

One of the outstanding rooms in the ship is undoubtedly the lounge at the after end of the promenade deck. It has windows on three sides, and looks directly aft on to the sports deck already referred to. It has a stage and a cinema screen and provision is made for dancing.

PROPELLING MACHINERY OF THE CUNARD WHITE STAR LINER "MEDIA"





ENGINE ROOM AND BOILER ROOM

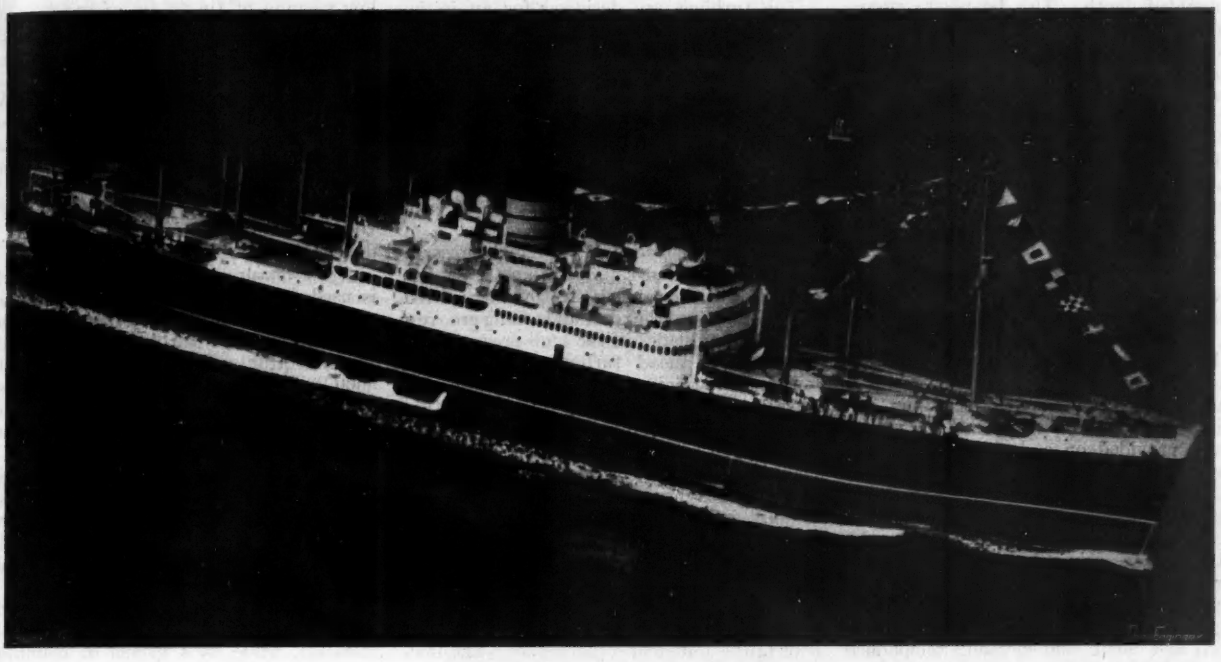
In the promenade deck entrance hall there is a shop, and on "A" deck amidships is the main entrance hall for passengers with the purser's office and the telephone kiosk.

The dining saloon, a view in which is given herewith, is on "B" deck, and it extends the full width of the vessel. It is also air conditioned, and the tables are conveniently laid out, with the smaller luminous call system is provided. In the private bathrooms all plumbing work, we noted, is concealed in special pipe spaces. We show in the accompanying engraving a typical cabin.

Very special care has been given to the accommodation for the captain, officers and crew, and an unusually high standard has been reached in this respect. The entire is by the cafeteria system. Space forward on the "B" deck is set apart for the use of the crew with a special bar.

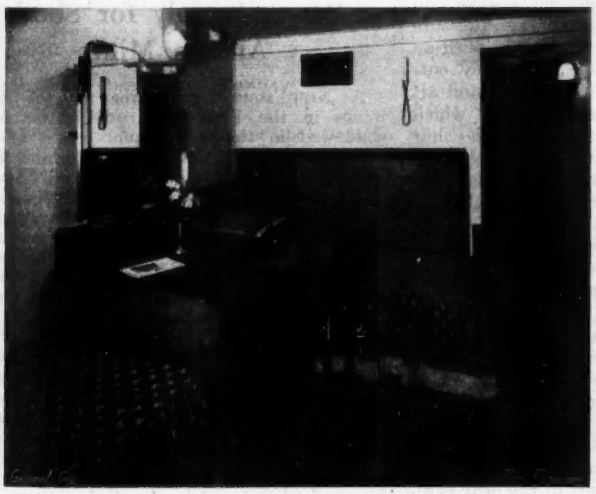
Deck Machinery and Navigating Instruments

The cargo-handling arrangements are very comprehensive. The six hatches are served

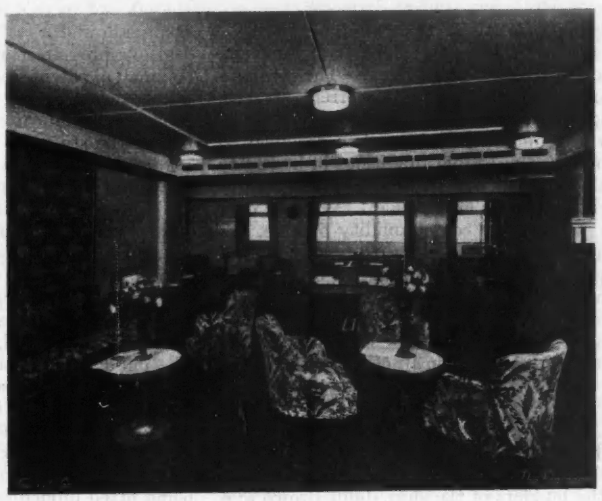


CUNARD WHITE STAR LINER "MEDIA"

tables in twos, fours and sixes. The portholes are faced with sliding windows, and hidden lighting lends a sunlight effect. On the forward bulkhead is a decorative painting by Mr. H. Adam Crawford. Kitchen equipment by Henry Wilson and Co., Ltd., is boat deck superstructure is set apart for the captain's suite, and for the accommodation for the navigating and engineer officers. The captain's rooms, and those for the navigating officers, are forward, and have their own wardroom and pantry, while the engi- by five sets of Samson posts, with tubular steel derricks in addition to the derricks stepped off the mast. Altogether there are eight 10-ton and twelve 5-ton derricks, served with Laurence-Scott electric winches. A portable derrick permits the handling of



A TYPICAL CABIN



DRAWING ROOM AND LIBRARY

provided, and the total electric loading of the cookers is about 150kW.

In the cabins to which we have already briefly referred there are two full-sized beds, with, in some cases, an additional Pullman berth for a three-berth room. The fittings include an electric heater, and a variable-speed fan, with a dressing table and wardrobe, and space for baggage. The "Gent" neers who are berthed on both sides of the funnel and engine-room casings have their own mess room and wardroom. The sailors and firemen are, we noted, quartered in two-berth cabins, and the cook and stewards in four-berth cabins, and by special wish some larger six-berth cabins with tables and chairs, for games. Separate mess rooms are provided for and service loads up to 50 tons. The 'tween decks and holds are arranged mostly for general cargo but forward a number of the 'tween deck compartments are insulated for the carriage of refrigerated cargo.

The refrigerating machinery for cargo and ship's provisions and domestic use was designed and installed by L. Sterne and Co., Ltd., of Glasgow. It comprises five specially

designed "Freon 12" compressors with their condensers and sea-water circulating pumps. The compressors are driven by electric motors and are housed in a special engine-room forward of the boiler-room. Two of these refrigerating plants are designed to work on the air-conditioning load.

The eight steel lifeboats are of Mechan's design and construction, and are carried in Welin McLachlan gravity type davits. The boat dimensions are 26ft by 9ft 1½in, with a 4ft moulded depth. Two boats are engine propelled, two furnished with Fleming hand propelling gear, and the remaining four arranged for rowing with oars.

The ship is furnished with two stockless bower anchors, each weighing 104½cwt, and an 89-cwt anchor is also carried, chain cable to a length of 330 fathoms being provided.

The electro-hydraulic steering gear was designed and supplied by Brown Brothers, of Edinburgh, and is similar in principle to that installed in the "Mauretania." Fire precautions include the fitting of Mather and Platt "Grinnell" sprinklers and indicator in the wheelhouse, and the Lux Rich Company's CO_2 smothering system for the cargo holds with a smoke indicator in the wheelhouse.

The engine-room bridge telegraphs are by Siemens Brothers, and docking telegraphs are also provided on a docking bridge aft. Sperry gyro compass repeaters are fitted both in the wheelhouse and in the radio room, and are operated from a master compass. An echo-sounder is carried in the chart room. The Metropolitan-Vickers radar installation is arranged on the compass platform above the navigating bridge, with the viewer in the wheelhouse. Clifford and Snell loud-speaking telephones are installed, for communication between the bridge and engine-rooms, and for docking operations. Other apparatus includes the International Marine Radio Company's radio-telegraph, radio-telephone, and public address services.

The ventilating and heating systems for public rooms include Thermotank punkah louvre fittings and fans, while for the engine and machinery spaces six Axia fans are used, four of which are 40in in diameter, and are each built to handle 18,000 cubic feet of air per minute, and two of 30in diameter, each handling 10,000 cubic feet. The air-conditioning plant already referred to was designed and installed by the Carrier Engineering Company, Ltd., and is designed to maintain comfortable conditions of humidity in all the rooms, with outside temperatures from 30 deg. to 90 deg. Fah. With 90 deg. Fah. and 75 per cent humidity outside, the plant is designed to maintain 82 deg. Fah. and 55 per cent relative humidity in rooms fully occupied, while in cold weather it is designed to maintain a temperature of 70 deg. Fah., with 45 per cent relative humidity within the rooms. Automatic air control is provided for.

Main Propelling Machinery

The boilers and twin-screw propelling machinery for the "Media" were designed by the builders of the ship, John Brown and Co., Ltd., of Clydebank, and incorporate the latest features in high-temperature water-tube boiler and high-speed geared turbine practice. Views are reproduced on page 228.

The boiler installation comprises two Yarrow side-fired, three-drum type boilers with superheaters and Foster-Wheeler tube type economisers. The steam pressure at the superheater outlet is 430 lb, and the steam temperature 750 deg. Fah. Howden forced and induced draught fans are used. The oil burning system is that of Wallsend-Howden, and it incorporates the latest improvements.

The main turbines were designed in collaboration with Parsons Marine Steam Turbine Company, Ltd., and each set consists of an impulse reaction high-pressure turbine, and an all-reaction single-flow low-pressure turbine working in series. Each turbine drives a separate double helical double reduction pinion, which engages with the main gear wheel.

The turbines are designed for an initial steam pressure of 415 lb per sq in G., a steam temperature of 740 deg. Fah., and a vacuum of 28·5in Hg. at the top of the condenser. The service power of the installation is approximately 13,600 s.h.p., and the maximum power is approximately 15,000 s.h.p. Astern power is provided by a simple astern turbine consisting of 1-3-row wheel, incorporated in the aft end of each low-pressure ahead casing.

The impulse blades of the high-pressure ahead turbine and astern turbine are made of Firth's F.G. stainless steel and are fitted individually into the rotor and casing grooves. The reaction blades in the high-pressure and low-pressure ahead turbines are made of low carbon stainless iron and are assembled in sectors held at the roots by a foundation wire and brazing and secured by side locking strips. The astern turbine nozzle plates are made of phosphor-bronze with cast iron vanes of Staybrite F.D.P. steel. A thrust dummy is fitted in the high-pressure and low-pressure ahead turbines and any unbalanced axial thrust is carried by a Michell thrust bearing.

The high-pressure casings are constructed of cast steel, while the low-pressure casing is of fabricated steel construction. The low-pressure turbine barrel and dummy cylinder is made of cast iron, while the astern nozzle box is made of cast steel, the whole unit being fabricated to steel plates. Shields are fitted to the astern blades in way of the bottom half of the casing.

A bracket supports the high-pressure and low-pressure turbines at the aft end of the gear case and at the forward end on the engine seating. The turbines are rigidly bolted at the aft end to this bracket, the forward end being allowed to slide. The high-pressure and low-pressure turbines are fitted with an Aspinall's patent duplicate emergency cut-out governor arranged with forward and aft movement indicators and control, which causes the steam to the turbines to be shut off in the event of the turbine revolutions per minute exceeding a predetermined figure. The governors control the main bulkhead steam valves, through the medium of the lubricating oil system and steam is also automatically shut off in the event of an undue drop in lubricating oil pressure.

The reduction gearing is of the conventional double helical, double reduction type. The pinions and gear wheels are housed in a mild steel fabricated gear case, the main engine turning gear being secured at the aft end of the gear case. The latest Michell type of single-collar thrust block is fitted, and it carries the propeller thrust, each block being fitted immediately aft of the gear case. The propeller shafting is made from solid mild steel forgings and is well supported by Michell shaft bearings, and the propellers supplied by J. Stone and Co., Ltd., are of the "Scimitar" type with four blades. A Siemens Ford torsionmeter for power measurement is fitted to each shaft.

The Weir closed system has been adopted for the condensers, which are underslung below the respective low-pressure turbines and were built at Clydebank. Each condenser has a cooling surface of 6500 square feet, and is made up of 2810, ¾ in outside diameter tubes, secured in the tube plate by Crane's flexible metallic packing at the outlet end and Wilkie's packing at the inlet end. A new feature is the gland evacuation system on the main turbines. Each of the glands on the high-pressure and low-pressure turbines is of two pocket design, the inner pocket, adjacent to the turbine, being the packing pocket. The outer pocket is coupled to a gland-evacuation condenser, in which a low vacuum of 1in to 2in of water is maintained. By this means, water loss, engine-room humidity, and casing sweating are reduced to a minimum.

Among the auxiliary plant we noted Weir evaporators and distilling plant and Drysdale service pumps of various kinds, also De Laval oil purifiers. A waste heat boiler is installed at the forward end of the engine-room, and there are two Cochran oil-fired boilers for 100 lb steam, for the ship's heating and domestic requirements.

A new feature is the steam generator which is used at sea under full power conditions, when steam is bled from the first stage of the high-pressure turbine and supplied to the generator, which has a duty of about 5000 lb of steam at 100 lb gauge pressure. A connection to the main boilers for direct steam supply is also provided. The main generating plant consists of four Ruston and Hornsby seven-cylinder marine oil engines, directly coupled to 375-kW General Electric Company 220-V generators. Distribution of current is effected through auxiliary switchboards, which are placed at vantage points in the 'tween deck spaces. For emergency service, a 50-kW oil engine-driven generator set above the bulkhead deck is installed, while as a means of maintaining light in the interval between a possible failure of the main supply and the starting up of the emergency set, there is a 220-V battery, which serves the emergency lighting system as soon as the main current fails.

Power Supply for South African Mines

A New source of power for the gold mines in the Free State, which was foreshadowed in the last annual report of the Electricity Supply Commission, has now been decided upon. The power station will be built at Vierfontein in the Klerksdorp district, on a coalfield which has been discovered in the area. The Vaal generating station across the river just beyond Vereeniging is providing the initial supply of energy for the developing mines in the Free State, the transmission being by means of 80,000-V lines, which are now stretching across the veldt, on pylons and are nearing the new goldfield. But this will be insufficient when the mines reach production, and in the intervening period a new power station will be built at Vierfontein. Four Free State mines have started shaft-sinking, and another four are due to begin shortly. By the time the new station is built additional electric energy will be required and will be supplied thereby. In the Vierfontein area the coal deposits are estimated at 700,000 tons. Although the coal is of low grade, judging by the results of forty-two bore-holes which were sunk, it is suitable for feeding into furnaces by the "spray" process in "duff" or pulverised form. The new power station will not only serve the mines in the Free State, but the whole area from Klerksdorp to Kimberley. The railways have in hand the electrification of the line from Randfontein to Welverdiend, and the current from the new station may also be used for traction purposes.

Field Tests on 132-kV Cable Installation

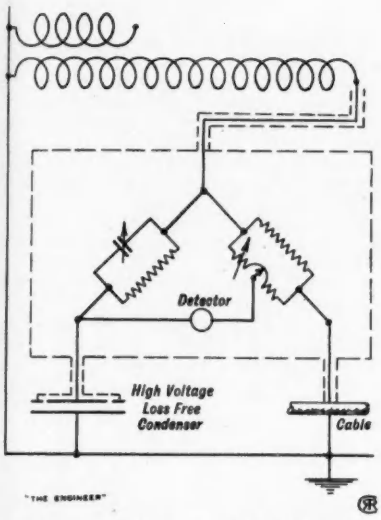
OF the many tests to which high-voltage cables can be subjected during manufacture and afterwards not the least important to manufacturer and user alike are those involving dielectric loss measurements on cable installations *in situ*. For no other test provides such reliable data about the dielectric condition of a complete cable installation. Furthermore, by repeating these loss measurements periodically an early indication can be obtained of any deterioration that may take place in the general insulation level, with the passage of time, so that steps can be taken to safeguard vital circuits before breakdown occurs.

An interesting test of this kind was carried out recently at Hams Hall "B" generating station by British Insulated Callender's Cables, Ltd., in collaboration with the City of Birmingham Electricity Supply Department. The purpose of the test was to confirm by site measurements the dielectric quality of a newly installed run of 132-kV impregnated pressure cable. This particular installation comprised three 295-yard lengths of single-core 0·4 square inch impregnated pressure cable for the 50-MW turbo-alternator which is due shortly to be placed in commission.

Field measurements on lengths of cable in service using the earthed Schering bridge have been made occasionally in England at various times during the last twenty years. The novelty of the recent tests at Hams Hall arises from the use of an inverted bridge circuit with a Faraday cage which allowed the measurements to be made with the bridge and operator at a high voltage above earth instead of being at earth potential. This technique, the advantages of which are outlined below, was first used in England in August, 1946, for tests on 66-kV cables at Ferrybridge generating station in collaboration with the Yorkshire Electric Power Company.

The Schering Bridge

Normally measurements of cable dielectric loss angle are made by means of a modified Schering bridge circuit, the cable to be tested being considered as a leaky condenser, and balance being obtained against a standard condenser of known value. When the conventional Schering bridge circuit is applied to buried cable, however, several difficulties arise, for the test capacitance is, of course, earthed on one side, and correction factors involving the vectorial subtraction of dielectric losses in the leads from the test transformer, and in the transformer itself, must be applied. This method is rather cumbersome and involves considerable calculation so that an "inverted bridge" circuit is used as shown in the accompanying schematic diagram.



SCHERING BRIDGE IN FARADAY CAGE

The Faraday Cage

It will be seen from this diagram that an inverted bridge circuit makes it necessary to raise all components of the bridge to the test voltage. Adjustment of variable components must, of course, be made during the test, and so, to avoid the necessity for fitting long insulated handles to the apparatus, thereby introducing stray capacitance losses which would seriously affect the conditions of balance, the apparatus and the tester are enclosed in a wire mesh Faraday cage mounted on high-voltage insulators. The tester within the cage is thus charged with the cable and instruments to the full test voltage while measurements are being made. This arrangement excludes all losses from the circuit except those present in the actual cable installation under test.

The photograph reproduced in the accompanying engraving gives a general view of the test arrangements, showing the test engineer at the controls of the Schering bridge inside the Faraday cage.

On the immediate right of the cage this view shows the nearest of the three cable terminal posts mounted on its concrete pedestal.

An interesting form of detector is used for indicating the balance condition in the bridge circuit; it consists of a three-stage battery-operated amplifier coupled to a "magic eye" tuning indicator. This arrangement is capable of much higher sensitivity than the conventional vibration galvanometer which is normally used in measurements with the Schering bridge. Our engraving shows the detector mounted in a small cabinet conveniently placed at eye level on the control desk.

A portion of the "standard" loss-free condenser, which forms part of the bridge circuit, can be seen projecting to the left of the cage. This gas-filled condenser, which is manufactured by Gambrell, Ltd., is suitable for voltages up to 250kV and has a capacitance of 100μμF at a gas pressure of 200 lb per square inch. The Faraday cage itself, as used in this test was designed and constructed at the research laboratories of British Insulated Callender's Cables, Ltd., in Wood Lane.

FARADAY CAGE

Test Results

As a preliminary check on the soundness of the insulation the cables were first subjected to the customary d.c. over-voltage test at 264kV. Power factor measurements were then made on each phase in turn at various a.c. potentials up to 76kV, the phase-to-earth working voltage.

The results are given in the accompanying table. It should be borne in mind that the values of power factor obtained are of the complete installation and not of the cable alone:

Test Results

	kV to earth	Power factor
Red phase	10	0·0020
" "	20	0·0021
" "	35	0·0021
" "	50	0·0021
" "	76	0·0021
Yellow phase	10	0·0020
" "	24	0·0020
" "	35	0·0021
" "	50	0·0021
" "	76	0·0021
Blue phase	12	0·0020
" "	20	0·0020
" "	35	0·0021
" "	50	0·0021
" "	76	0·0021

Evidently laboratory determinations cannot provide the valuable information that is obtainable from field tests of this kind carried out from time to time during the service life of a complete installation. These tests therefore provide fresh evidence of the mutual advantages to be gained by improvements in technique which depend so much upon co-operation between the manufacturer and the supply authority.

BRITISH SURPLUS STORES FOR POLAND.—Shipment to Poland is now beginning of large quantities of British Government surplus stores and equipment. Raw wool, cotton, textiles, reconditioned Service clothing, footwear, machine tools in large numbers, cranes, pumps, fire-fighting equipment, telephone equipment, and small craft are among the very wide range of goods selected for despatch to Poland. The goods have been made available under a financial agreement, concluded over a year ago with the Polish Government and ratified by Britain in June of this year. It provides for the transfer to Poland of £6,000,000 worth of British surplus goods. A Polish mission, headed by Mr. K. Arnold, is at present in this country for the purpose of selecting the goods from depots in all parts of the country. A proportion is also being selected from depots on the Continent and in Africa. It is expected that the mission will have completed its task in the course of the next few months.

Industrial and Labour Notes

The Trades Union Congress

The seventy-ninth Trades Union Congress opened at Southport on Monday morning last, under the presidency of Mr. G. W. Thomson, and has continued throughout this week. There are 836 delegates attending the Congress, representing 187 trade unions, the total membership of which at the end of last year was 7,540,397.

In the course of his presidential address, Mr. Thomson said that the T.U.C. was in course of meeting unions to consider suggestions for speeding up production. It might be that some of the incentives and measures which would be proposed within industry itself would not meet with general approval, and it might tax the powers of leadership in the unions and in the T.U.C. itself to overcome difficulties. Referring to present-day financial and economic difficulties, Mr. Thomson commented that last winter's crisis emphasised the shortage of manpower and, to some extent, its maldistribution. That, he thought, was still the problem, although it was now much more obvious that there would have to be more authoritative planning of production on a wide scale, with attention devoted to longer-term economic policies

Mr. Thomson went on to say that management might and could do much more to increase its efficiency by wise provision in the way of up-to-date plant kept in good condition and securing its raw materials at the right time and place so that machines were not starved nor shops choked. Anything that could be done by workers to help in that task should be welcomed, and joint production committees and similar machinery, which had been helpful in the war years, could be even more helpful in the future if firmly established and adequately used. The trade union movement, Mr. Thomson declared, would find for itself wide usefulness in that way and, in deliberately seeking to improve production, would find an added incentive in its own work. By joint consultation between trade unionists and employers, by the exercise of the initiative of which people in industry were capable, he felt sure that, even with shortages of raw materials and manpower, production could be increased materially.

Direction of Labour

Before the Trades Union Congress opened at Southport, the general council issued a supplementary report on developments in the economic situation. The report, which was discussed on Tuesday, indicated that the general council accepted the Government's view that the forthcoming Control of Engagement Order would involve a limited direction of labour in order to secure the better distribution of manpower and to utilise all available resources for the economic recovery of the nation.

The report stated that a letter had been received from the Minister of Labour intimating that the Government's view was that, while there should be no general resumption of the use of the power of direction, it should be used, if necessary, where a person seeking employment through an employment exchange refused to accept one of a number of essential jobs offered.

Wage Negotiations

Another matter dealt with in the T.U.C. general council's supplementary report related to information about wages. It was stated that the Cabinet, while rejecting the doctrine that wages should be settled by the Government, thought that more information should be available to the Government about what was actually happening or likely to happen in the way of wage movements. The intention was, therefore, that the Minister of Labour should establish a branch to collect and collate information on wages and hours. If there was any delay in the settlement of a wage dispute, the Ministry would be, with the greater knowledge at its disposal, in a better position to endeavour to speed up a settlement.

The T.U.C. and the Coal Industry

A special declaration on matters connected with the coal-mining industry was put before the opening session of the Trades Union Congress on Monday last, and was unanimously approved. The declaration said that an economic crisis of unprecedented gravity imperilled the safety of the nation, and in the united efforts that all must make to meet the nation's needs, the mineworkers had a vitally important contribution to make to the security and wellbeing of the British people and to the world's economic recovery.

References were then made to the nationalisation of the coal industry and to the far-reaching plans for its reorganisation, which were in hand. The T.U.C. declaration continued by saying that with less machinery than the mining industry would eventually have, and with smaller manpower than would presently be obtained, an appeal must be made, in the national interests, to all those engaged in the industry now to increase the output of coal in order that the target set for the industry should be met and, if possible, exceeded.

The declaration went on to pledge T.U.C. support for the mineworkers in the endeavours of their union to improve conditions of work and welfare in their industry. For their part, the mineworkers were urged to realise that the speedy attainment of their aims depended upon the industry's ability to secure an immediate and substantial expansion of output.

It was the desire of the trade union and labour movement, the declaration concluded, to do justice to the miners' claim that their industry should be treated as a national service. By the reduction of absenteeism, by their loyalty to their union in avoiding all unofficial stoppages of work, by assisting the entry of more workers to the industry, and by the acceptance for the time being of the proposal to work additional hours, and by giving sustained effort at the coal face and in the raising of coal to the pithead, the mineworkers would earn the respect and gratitude of the nation.

The Yorkshire Coal Strike

An unofficial strike of miners at various collieries in Yorkshire has resulted in a considerable loss in the coal output of that area. The strike actually started at Grimethorpe, on August 11th, when 140 face workers refused to work an extra 2ft stint. The National Coal Board took the view that the strikers had themselves terminated their contracts by not returning to work, and during last week other stoppages occurred in sympathy with the Grimethorpe dispute, involving approximately 16,700 men from sixteen collieries. The increased stint, it may be said, was decided upon by the pit management in order to make up a full day's work under the five-day week agreement, and attempts to settle the dispute by means of the approved conciliation machinery were not successful.

During last week-end, the Minister of Fuel and Power, Mr. E. Shinwell, and the general secretary of the National Union of Mineworkers, Mr. Horner, addressed meetings in the strike area, and on Monday morning it was announced that eleven of the sixteen pits affected had resumed work. On Monday evening, however, it was estimated that 8000 miners had not returned to work, including those at Grimethorpe, and as we go to press the situation seems to have deteriorated. It is reported that over 30,000 miners employed in twenty-six Yorkshire pits are on strike, and that the daily loss of coal output is about 40,000 tons.

The Factories Act and Staggered Hours

It was suggested some months ago that certain modifications of the Factories Act might be essential if schemes for the staggering of working hours, to spread the electricity load, were to be successful. Early this week it was announced that, under emergency powers, the Minister of Labour has made a new Order known as the Factories (Hours of Employment in Factories using Electricity) Order, 1947, which permits conditional exemption from some of the provisions of the Factories Act, 1937. The Order, which becomes effective on September 22nd, applies to factories in which electricity generated outside is used for purposes other than lighting or ventilating. Certificates permitting relaxation may be issued by district inspectors, and the Order allows the period of employment on day work to begin at 6 a.m. instead of 7 a.m. for persons aged sixteen or over. Alternatively, except on the weekly short day, the period of employment may end at 11 p.m., instead of 8 p.m., for persons aged sixteen or over, and at 6.30 p.m. instead of 6 p.m. for those under sixteen.

For persons aged sixteen or over the total number of working hours in a week may exceed forty-eight, but must not be more than an average of forty-eight a week over two consecutive weeks or over such a period as appears reasonable to a factory inspector. Where an employment period ends not later than 7.15 p.m. an afternoon spell of work may be as long as six hours, provided there is a minimum break of a quarter of an hour. Saturday afternoon or Sunday work may be permitted provided other rest days are substituted.

The Order permits night work for women aged eighteen and over and for youths over sixteen, with certain limitations. It must not be on more than six nights in a week, with a maximum of forty-eight hours a week and nine hours a night, or ten hours if only five nights are worked. The period of work on any night is not to exceed eleven hours, or twelve hours if only five nights a week are worked and must not begin before 7 p.m. or end after 8 a.m.

The Ministry of Labour explains that the Order allows a wide variety of arrangements for staggering working hours. It will enable double day-shift working to be undertaken by women and young persons of sixteen or over and day and night shift working or three-shift working by women aged eighteen or over and youths aged sixteen or over. It should be noted, however, that the special exceptions in the Factories Act remain in force, and that the Order makes no provision for the employment of persons under sixteen before 7 a.m. or after 6.30 p.m. or for the employment of girls between sixteen and eighteen before 6 a.m. or after 11 p.m.

Market Research

The Manchester Joint Research Council, which was formed nearly three years ago, has made considerable progress in its efforts to strengthen the links between science and industry. Meetings and conferences have been organised, and through the Council's information service, traders and scientists have been brought into closer contact for the benefit of the community in general.

The Council is now making arrangements to hold a one-day conference dealing with market research on Wednesday, October 22nd, in the Albert Hall, Peter Street, Manchester. Professor John Jewkes will preside over the morning session, beginning at 10.30 a.m., and papers on "The Technique and Applications of Market Research," by Mr. O. W. Roskill and "The Investigation of Trends of Consumer Tastes," by Mr. H. D. Willcock, will be discussed. At the afternoon session, Mr. E. A. Carpenter will preside, and Mr. D. S. F. Vernon will present a paper on "Market Research and the Seller." Later in the afternoon the proceedings at the conference will be summed up by Mr. C. G. Renold, chairman of the British Institute of Management.

French Engineering News

(From our French Correspondent)

PARIS, August 29th.

It is thought that France may possess sufficient crude oil to satisfy her own consumption, but the research and drilling necessary to locate it is at the moment a slow business due to the lack of material, labour and capital. In addition to the inferiority of French tools which makes imports necessary, skilled labour is also lacking and a National Petrol Institute has been created to group under one organism the technical education of personnel employed in the industry. It is subdivided into a National Technical School which turns out engineers, and a school for master-prospectors which gives instruction to skilled workers in the different plants. The first specialists were formed from a nucleus of French engineers who received their instruction abroad.

In 1944, a school for master-prospectors was created at Saint-Gaudens with the assistance of sixteen professors (engineers and foremen). Already twenty-five master-prospectors have been trained and they will continue to perfect their knowledge while working, for it is considered that five years are needed for the creation of an experienced driller.

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Import provisions for steel and iron in 1947 are likely to be largely insufficient in quantity, but excessive in price, which is expected to weigh heavily on the national economy. Following a question about subsidies to the steel industry, the Minister of Production stated that the industry was supporting enormous expenses, and the situation was not easy. An inquiry is at the moment being carried out by experts of the Ministry of National Economy, and when the result is known, it will be possible to pronounce definitely on the subsidies to be allocated to the industry. The Minister is definitely against distributing subsidies before the experts' report is available. He wishes to take into account output, equity and the real situation. In fact, he is against the former practice of distributing a subsidy proportional to turnover, but intends to take into consideration the price of each category of product.

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The big Tignes and La Girotte dams are two elements of the French hydro-electric scheme for harnessing torrents in the Alps, the Pyr n es, the Massif Central, on the Rhone and the Rhine. In addition, thermal plants will be improved so as to diminish their coal consumption by 30 per cent. In four years' time France expects to have completed the first stage of her hydro-electric equipment plan and will dispose of twice the quantity of power. Because there are not yet sufficient reservoirs to regulate seasonal flow, however, it is necessary to retain and improve thermal plant to provide the extra power needed in December and January. Altogether 90 milliard francs will be necessary to cover the hydro-electric work and 19 milliards for the thermal plant. In addition, 20 milliards will be needed for cables. A 400,000-V network is being installed in addition to the present 220,000-V network. Total credits needed are estimated at 249 milliard francs. There is some difficulty in recruiting skilled labour. At the moment 30,000 men are working on hydro-electric plant, but the figure must be increased to 60,000 shortly. It is likely that an appeal will be made for foreign labour for this work.

* * *

French technicians estimate present steel production capacity at 10 million tons a year. Actual production, however, is only 5·8 million tons, owing to shortage of coal and coke. In order to meet present requirements and ensure the success of the Monnet Plan, 7·5 million tons are needed. Machine tool production, which had fallen off slightly, is now back to normal, but automobile production, which was about 37,000 vehicles in the first quarter of 1947, amounted to only 34,000 in the second quarter owing to strikes. Automobile production, however, is still higher than that of 1946.

Notes and Memoranda

Rail and Road

GIFT TO YORK RAILWAY MUSEUM.—A lithograph drawn on stone by G. J. Frankland from a contemporary drawing by a Mr. J. Green, architect, of Darlington, of the Northallerton Station of the period of 1845 when it was operated by the Great North of England Railway, has been presented to York Railway Museum. The presentation has been made by Mr. Ernest Beecroft, of York, who has just retired after forty-five years' service with the L.N.E.R. and its predecessors.

ROYAL ALBERT BRIDGE, SALTASH.—The Great Western Railway announces that the Royal Albert Bridge, Saltash, is to be repainted. The bridge, which is regarded as Brunel's railway masterpiece and is the link between Devon and Cornwall, stretches nearly half a mile and rises 180ft above the River Tamar. In view of the shortage of materials, only the most exposed parts of the bridge will be repainted after cleaning and scaling. The most difficult part of the work will be the two big tubular trusses which form the centre spans, each of which is 455ft long.

LONDON TRANSPORT "SUGGESTIONS" MOVEMENT.—London Transport workers are taking part in a big campaign to make London Transport more efficient than ever. They are doing it under a scheme started by the Board whereby rank and file workers receive monetary awards for ideas submitted with a view to improving the service. Entries in the scheme are secret and the judges do not know the name of the originator of an idea until it has been approved. The scheme is being taken up enthusiastically by the staff, and it is stated that scores of suggestions for ideas to give better service are being received and put into operation.

SLOW-MOVING LONDON TRAFFIC.—The restrictions on slow-moving traffic in certain key streets in the City of London, announced last May by the Minister of Transport, came into force on August 21st. Mechanically propelled vehicles restricted to a speed of 5 miles an hour, horse-drawn and hand-propelled vehicles are now prohibited by Regulations made by the Minister under the London Traffic Act, 1924, from using scheduled streets between 9 a.m. and 11 a.m., and 4 p.m. and 6 p.m. on Mondays to Fridays, inclusive. As the prohibition is limited to hours when traffic is heaviest, only vehicles in the service of a local authority, which are being used for the maintenance of essential street services, are exempt from the Regulations.

G.W.R. HISTORIC RESTAURANT CAR.—Bronze plaques have been fitted to the historic Great Western Railway restaurant car No. 9673 to commemorate its service in the wartime special train used by Mr. Churchill, the British Cabinet, American and British Service Chiefs, and in France and Germany by General Eisenhower as part of his mobile headquarters during the Second Front campaign. The plaques bear the following words :—"This restaurant car formed part of the special G.W.R. train which was used in this country by members of the British, American and other Allied Service Chiefs, and during the operations in Europe became the mobile headquarters of General of the Army Dwight D. Eisenhower, Hon. G.C.B., O.M., Supreme Commander of the Allied Expeditionary Force in Western Europe, and his staff until the close of hostilities in 1945."

Miscellanea

THE LATE MR. G. W. CLARKE.—We note with regret the death, on August 16th, of Mr. George W. Clarke, of A. C. Wickman, Ltd., Coventry. He had served the company since 1938 as a specialist on gear and spline grinding, having been previously works superintendent of the Gear Grinding Company, Ltd., Birmingham. Amongst the work carried out under his direction was the complete installation of all the gear grinding equipment at the Fiat factory in Milan in 1934.

THE CONTROL OF MAGNESIUM.—The Minister of Supply has made an Order revoking the Control of Magnesium (No. 4) Order, 1942. The effect of the revocation, which came into force on September 1st, is to free the acquisition, disposal, and use of all forms of magnesium and magnesium alloys from licensing and to remove price control. The Ministry of Supply has now ceased to sell magnesium direct to consumers. Arrangements have been made for supplies of magnesium to be distributed by F. A. Hughes and Co., Ltd., who will sell pure metal to all United Kingdom consumers without restriction at 1s. 2d. a pound delivered.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—The jubilee of the Institution of Heating and Ventilating Engineers, founded in 1897, is to be celebrated in London on Tuesday and Wednesday, October 7th and 8th. The celebrations begin with a banquet, followed by dancing at the Savoy Hotel, Strand, W.C.2, on Tuesday, October 7th, at 6.30 for 7 p.m. On Wednesday, October 8th, meetings will be held, at a place to be announced later, at 2.30 p.m. and 6 p.m., when papers will be presented by Mr. C. G. Vokes on "Air Filtration," and by Mr. C. G. Carrothers on "District Heating."

THE SCIENCE OF REFRIGERATION.—The second annual session of the course in the Science and Technology of Refrigeration, which was established last year by the Institute of Refrigeration and the British Refrigeration Association, will begin at the Borough Polytechnic, London, on Monday, September 15th. This is a whole-time six-months' course of 600 hours' tuition, open to students of National Certificate standard. The syllabus of the course is identical with that of the entrance examination of the Institute of Refrigeration. Full particulars may be obtained on application to the Principal, Borough Polytechnic, Borough Road, London, S.E.1.

PROPOSED NEW TOWN AT EASINGTON.—A proposal to establish a new town for some 30,000 people near Easington, Co. Durham, was discussed at a meeting between the Minister of Town and Country Planning and local authorities in the area on August 27th. A letter sent by the Ministry to local authorities states that the town would be a balanced community, its citizens being drawn in the main from persons now living in unsatisfactory conditions in the rural district. Existing opportunities of local employment would be supplemented by the introduction of suitable additional industries. Development of the town would be by a Development Corporation set up under the New Towns Act, 1946.

GAUGE AND TOOL MAKERS' EXHIBITION.—The Council of the Gauge and Tool Makers' Association has decided to arrange another exhibition in January and February, 1948. It has been agreed on this occasion to invite the co-operation of the National Federation of Engineers' Tool Manufacturers, and with that object in view the Old Hall as well as the New Hall of the Royal Horticultural Society, Vincent Square, S.W., has been reserved. The total area for the joint exhibition, as represented by the two halls, will be 32,000 square feet, and the exhibition will be open daily from Monday, January 26, to Friday, February 6, 1948, excluding Sunday, February 1st. As at the last exhibition, the stands will be of uniform size and design throughout. Further particulars may be obtained from the Gauge and Tool Makers' Association, Standbrook House, Old Bond Street, London, W.1.

THE LATE MR. A. SOUTHWORTH.—We regret to have to record the sudden death, on August 20th, of Mr. A. Southworth, chief engineer at the Witton works of the General Electric Company, Ltd. Mr. Southworth, who was forty-seven, was educated at Liverpool University and held the degree of B.Eng. He was apprenticed with Dick Kerr and Co., and after serving in the Army in the 1914–18 War, returned to that company as a designer specialising in traction. He joined the General Electric Company, Ltd., in 1936 as chief of the traction motor design department. During the war he was engaged exclusively on development work in connection with large searchlights, radar and fire control problems. Since his appointment as chief engineer in 1945, Mr. Southworth had been actively engaged on the design of large alternators to meet the national requirements for generating plant.

THE SOCIETY OF ENGINEERS.—The examinations of the Society of Engineers, which were suspended during the war years, are now to be resumed, and arrangements have been made for holding them during the first week of November this year, and subsequently in May and November. The scheme provides for technical examinations in two stages: Graduateship, normally intended for students of engineering between the ages of eighteen and twenty-one years, and associate membership, for young engineers up to the age of thirty. Each examination comprises three sections—civil engineering, mechanical engineering, and electrical engineering, and candidates select the particular section most suited to their requirements. Further information, entry forms, syllabus of each examination and list of exempting qualifications can be obtained from the secretary, the Society of Engineers, 17, Victoria Street, Westminster, S.W.1.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Special Libraries and Information Bureaux

Saturday and Sunday, September 20th and 21st.—London School of Economics, Houghton Street, W.C.2. Twenty-second annual conference.

Engineering and Marine Exhibition

To-day, September 5th, to Saturday, September 13th.—London, Olympia.

Incorporated Plant Engineers

To-day, September 5th.—BIRMINGHAM BRANCH: Imperial Hotel, Temple Street, Birmingham. Paper, "Earth Moving Machinery." 7.30 p.m.

Tuesday, September 9th.—MANCHESTER BRANCH: Engineers' Club, Manchester. "Construction and Maintenance of the Manchester Ship Canal," P. N. Reed. 7.15 p.m.

Thursday, September 11th.—NEWCASTLE-ON-TYNE BRANCH: Y.M.C.A., Connaught Rooms, Blackett Street, Newcastle-on-Tyne. "Job 99, Pluto," Mr. Alexander. 7.30 p.m.

Monday, September 29th.—LEEDS BRANCH: The University, Leeds. "Lifting Tackle and Appliances," Mr. Platt. 7.30 p.m.

Institute of Economic Engineering

To-day, September 5th.—Cowdray Hall, Henrietta Place, S.W.1. "Personnel Selection: Army Experience in its relation to the Problems of Industry," Colonel B. Ungerson. 7 p.m.

Saturday, September 6th.—Midland Region: Chamber of Commerce, Birmingham. "Planning of Mass Production." J. Troth. 2.30 p.m.

Sunday, September 28th.—Waldorf Hotel, Aldwych, W.C.2. "Reflections on Productivity Assessment," J. Burgess. 2.30 p.m.

Saturday, October 4th.—MIDLAND REGION: Chamber of Commerce, Birmingham. "Time Study Allowances," S. Walford. 2.30 p.m.

Friday, October 10th.—Cowdray Hall, Henrietta Place, W.1. "A National Wages Policy," C. A. Lidbury. 7 p.m.

Institute of Marine Engineers

Tuesday, September 9th.—85, Minories, E.C.3. Presidential Address, Sir Amos L. Ayre. Paper: "Steam Pipework Design in Ships." Lieut. (E) P. T. Heath. 5.30 p.m.

Institute of Metals

Tuesday, September 23rd, to Friday, September 26th.—Annual Autumn Meeting at Glasgow.

Institute of Physics

Tuesday and Wednesday, September 16th and 17th.—The University, Leeds. Conference on Electron Microscopy.

Institute of Welding

Thursday and Friday, September 11th and 12th.—Addison Restaurant, Olympia, W. Autumn Meeting. 2.30 p.m. and 5 p.m.

Institution of Heating and Ventilating Engineers

Tuesday and Wednesday, October 7th and 8th.—Jubilee Celebrations.

Institution of Locomotive Engineers

Wednesday, September 10th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1. "The Westinghouse Empty and Load Brake with Straight Air Control: Its Installation, Operation and Maintenance," Brian Fawcett. 5.30 p.m.

Institution of Naval Architects

Tuesday, September 23rd, to Friday, September 26th.—Autumn meetings at Portsmouth and Southampton.

Institution of Production Engineers

Monday, September 8th.—LUTON SECTION: Town Hall, Luton. Film Shows. 7 p.m.

Monday, September 15th.—DERBY SUB-SECTION: Art School, Green Lane, Derby. "Motion Study." Miss A. A. Shaw. 6.45 p.m.

Tuesday, September 16th.—WOLVERHAMPTON GRADUATES: Visit to Hobson Aircraft Company, Ltd. 8.15 p.m.

Wednesday, September 17th.—BIRMINGHAM SECTION: James Watt Memorial Institute, Birmingham. "Cold Upsetting and Thread Rolling." T. C. Parker. 7 p.m.

Thursday, September 18th.—GLASGOW SECTION: Visit to Anderson, Boyes and Co., Ltd., Motherwell. 7.30 p.m.

Monday, September 22nd.—COVENTRY SECTION: Great Hall, Coventry Technical College, Coventry. "The Effects of the Change in the H.P. Tax upon Motor Car Production Engineering," Sir Reginald Rootes.

Wednesday, September 24th.—WOLVERHAMPTON SECTION: Wisemore Schools, Walsall. "The Future Development of Machine Tool Design," J. H. Wilkinson. 7 p.m.

Friday, September 26th.—LIVERPOOL SUB-SECTION: Adelphi Hotel, Liverpool. Inaugural meeting and dinner. 7 p.m.

Stephenson Locomotive Society

Saturday, September 6th.—NORTH-WESTERN BRANCH: Visit to Manchester Ship Canal Company's engine shed and depot. 2.30 p.m.

Works Management Association

Friday, October 3rd.—MANCHESTER BRANCH: Engineers, Club, Albert Square, Manchester. Discussion opened by A. P. Young.

Personal and Business

MR. G. BARROW has retired from the board of Revo Electric Company, Ltd.

MR. G. H. THOMAS has been appointed managing director of Massey Harris, Ltd.

MR. A. S. LOWE has been appointed secretary to the Electrical Fair Trading Council.

S. WOLF AND CO., Ltd., has recently opened an extension to its No. 1 works at Hangar Lane, Ealing, W.5.

MR. N. READMAN and Major R. E. L. Izod have been elected directors of the Consolidated Pneumatic Tool Company, Ltd.

THE LONDON, MIDLAND AND SCOTTISH RAILWAY announces that Mr. A. I. Macmillan has been appointed district engineer, Crewe.

THE LONDON, MIDLAND AND SCOTTISH RAILWAY COMPANY announces that Mr. G. L. Darbyshire has been appointed acting president.

THE LONDON AND NORTH-EASTERN RAILWAY COMPANY announces the appointment of Mr. C. B. Glenesk as district engineer, Glasgow.

MR. ROBERT CRAIL, director and general manager of Cunard White Star, Ltd., has been elected to the Mersey Docks and Harbours Board.

LAGONDA, Ltd., has completed an agreement to sell its factory at Staines, Middlesex, to a group headed by Mr. A. P. Good for the manufacture of a new range of oil engines.

MR. W. R. SELWOOD, machinery merchant and engineer, announces that he has transferred his business to premises at Bournemouth Road, Chandler's Ford, Southampton (telephone, Chandler's Ford 2275).

THE NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING has been transferred from its wartime location at Askham Bryan, York, to permanent headquarters at Wrest Park, Silsoe, Bedfordshire (telephone, Silsoe 305; telegrams, Ninagen, Silsoe).

MR. H. HALLIDAY has relinquished his appointment as Director of Refractories in the Ministry of Supply. All communications and inquiries regarding refractory products should now be addressed to the Ministry of Supply, Metals Division (M.2), Shell Mex House, W.C.2.

THE STAVELEY COAL AND IRON COMPANY, Ltd., has acquired the whole of the shares in Beswick's Limeworks, Ltd., Hindlow, near Buxton. The board of the latter company has been reconstituted, with Mr. T. A. McKenna as chairman and Mr. P. J. Beswick, managing director, the other directors being Mr. J. D. Berresford, Mr. G. W. P. Beswick and Mr. S. N. Turner.

THE SHELL PETROLEUM COMPANY, Ltd., announces that the section known as Fuel Oil General/Technical has now returned to St. Helen's Court, Great St. Helen's, London, E.C.3 (telephone, Avenue 4321). The Fuel Oil Technical Experimental Station remains at 25, Bagley's Lane, Fulham, S.W.6 (telephone, Renown 1234), under the control of Mr. N. M. Lawrance.

Reports on German and Japanese Industry

Limited numbers of copies of the reports of Intelligence Objectives Sub-Committees on German and Japanese Industry listed below can be obtained from H.M. Stationery Office at the prices stated.

No. of report.	Title.	Post free. s.	d.
F.I.A.T.			
392	Textile Machinery and Chucking Machines Manufactured by A. Monforts Maschinen-Fabrik at Munchen	2	2
879	Notes on the Peeling of Nickel Deposits	3	2
993	The Aluminium Reduction Industry in Germany	2	8
1009	Small Scale Sea Harbour Model Experiments: Report in German	1	7
J.I.O.A.			
58	Spectrographic Monitoring Equipment for Radio Stations	1	7
B.I.O.S.			
Misc. 19 ...	A Survey of German Wartime Food Processing, Packaging and Allocation: In two volumes:		
	Part I	22	11
	Part II	25	6
B.I.O.S.			
JAP/PR/173	Woods and Glues used on Japanese Aircraft	1	1
JAP/PR/612	Japanese Ships, Miscellaneous Items		7
JAP/PR/662	Culture and Utilisation of "Kozo" and "Mitsumata" for the Manufacture of High-Grade Paper in Japan	1	7
JAP/PR/675	Oil Fields of Hokkaido, Japan ...	2	2
JAP/PR/749	Lead-Acid Storage Batteries used by the Japanese Navy	1	7
JAP/PR/1445	A Metallurgical Examination of Two Japanese 7·7mm Aircraft Machine Guns of 1938 and 1942	2	2
JAP/PR/1450	A Metallurgical Examination of Four Japanese 47mm Armour-Piercing High-Explosive Shells	1	7
JAP/PR/1455	Metallurgical Examination of Japanese 47mm Anti-Tank Gun	3	6
B.I.O.S.			
394	Technical Report on the Ruhr Coalfield, Vol. III: Appendix 10: Safety Protection for Coal Face Lighting Circuits		7
	Appendix 11: The Introduction and Development of Plough Loaders in the Ruhr...		7
	These reports have been published separately by H.M. Stationery Office as M/Fuel and Power publications and should be ordered by title.		
1034	Allowable Gear Stress and its Calculation at Zahnradfabrik (Friedrichshafen)	1	7
1169	Investigation of German Water Treatment Industry Equipment and Methods of Treatment ...	6	2
1171	German Cotton Sewing Thread Industry	38	2
1195	German Wedge Wire Industry...	1	7
1256	German Razor Blade Industry...	7	6
1321	Control Instruments in the German Chemical Industry	14	4
1333	Final Report on German Naval Boilers with particular Reference to Design, Corrosion and Boiler Feed Water Treatment...	25	6
1338	Developments in Magnesium Production and Fabrication	7	9
1367	Henkel, Dusseldorf, Sodium Perborate and Sodium Percarbonate...	3	8
1393	Sodium Bichromate Production	1	7
J.I.O.A.			
46	Data on the German X-Ray Industry	7	9
57	Twelve-Channel Long-Distance Voice-Frequency Telegraph System	1	7
B.I.O.S.			
JAP/PR/678	Foodstuffs used in the Manufacture of Alcoholic Beverages in Japan	2	2
JAP/PR/847	Production of Tantalum in Japan	1	1
JAP/PR/1229	Acetylene Manufacturing Plants (Japan)	1	1
JAP/PR/1261	Oxygen Manufacturing Plants (Japan)	1	7
JAP/PR/1262–1263	Particulars of Docks in Japan and Extracts from Reports on Port Facilities in Japan	1	7
JAP/PR/1326	Japanese Motor Vehicle Industry	1	7
JAP/PR/1438	Metallurgical Examination of Armour Plate from Japanese Aircraft "Frank"		7
JAP/PR/1440	Metallurgical Examination of a Japanese Army 105mm H.E. Shell of 1938	1	1
JAP/PR/1442	Metallurgical Examination of Japanese 63-kg Bombs, Fuses and Gaines	2	2
JAP/PR/1443	Metallurgical Examination of Four Japanese 50-mm Grenades and Six Fuses	1	7

EVALUATION REPORTS, Price 2d. (post free 3d.)—

C.I.O.S.		
E/R/1	Professor R. Kuhn at the K.W.1 Organic Research	
E/R/69... ...	Junkers Werke, Dessau (Jume and JFA Plants)	
E/R/149 ...	Junkers Aircraft Targets at Dessau, Aschersleben, Bernburg, Raguhn, Schonebeck, Tarthum, Jessnitz, Halle and Schkeudits.	
E/R/212 ...	Report on Coal-Stripping Method and Equipment in Germany.	
E/R/250 ...	(Sect. 1) William Harry Lorsbach, (Sect. 2) Interrogation of Dr. Ing. Tank and Herr Lorsbach on a new form of Sponge-Plastic, (Sect. 3) Personal Statement of William Harry Lorsbach: Rubber and Foam-like Resins.	
E/R/371 ...	Coal and Coke Research at Firma Carl Still.	
E/R/375 ...	Werner and Pfleiderer: Macaroni Machinery.	
B.I.O.S.		
E/R/1	Deutsche Holzzucker und Chemische Fabrik A.G. Tornescher Hefe G.m.b.H., and Brennerei und Chemische Werke, Tornesch, G.m.b.H.: Wood Saccharification.	

B.I.O.S. Information Section, 37, Bryanston Square, W.1, which has at its disposal a considerable volume of information not in a form suitable for general reproduction, is prepared to receive enquiries regarding all problems relating to scientific and technical intelligence on both German and Japanese industry.